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THE POPULARITY OF SCIENTIFIC MEN.

IT can be in no wise claimed that the scientific man fills a very distinguished position in the mind of the public, for a discovery, if it is sufficiently showy to attract attention, may engender a sort of awesome admiration, but to render unto the scientist just tribute is completely beyond the power of popular discrimination. Indeed, we fear that public opinion of scientific matter is based largely on optical testimony. If allied to that testimony there is anything that excites curiosity or appeals to the love of novelty, then it is highly probable that such may be considered a remarkable invention.

Inappreciation roughly defines the attitude of the public towards the scientific worker. In this they but loyally follow the example of the Government, which rarely looks beyond the length of its own political nose. The greatest discoveries—great by reason of the benefits they confer upon humanity—have scarcely made one ripple on public opinion. No doubt men of science have cause for much thanksgiving. They are now permitted to live in comparative safety; they do not run the dangers that befell Tycho Brahe, Galileo, and others. They are not overmuch belauded, but they are not mobbed; they are not worshipped, but they are not inquisitioned. We are not going to bewail the circumstances which have decreed that many of our best men are born to blush unseen, nor are we going to take vengeance by stigmatising the public as a vulgar herd. But the fact remains that the social position of the scientific man is an indefinable one.

There have been signs, however, of a wakening to the social value of scientific men, and occasionally one has witnessed genuflecting feats by English newspapers in honour of foreign scientists. Seldom has an English newspaper enshrined in a leading article the deeds of a native scientific worker, save, perhaps, when he was compelled to become immortal, as the elder Chester would have said.

"The life of the distinguished man who invented the phonograph," from a true source, forms the subject of a recent editorial disquisition in the columns of the *Standard*. We learn several things from this. It appears that hitherto we have had only lives of Edison, now we have got to an authentic life. We do not gather from this much that is new; we are still informed that he once sold newspapers on board trains, that he waded through such ponderous tomes as Burton's "Anatomy of Melancholy," Hume's "England," Ure's "Dictionary of the Sciences," and that like Silas Wegg, he declined and fell. This authentic life contains two or three expressions of opinion from Edison, which are bold, but at the same time not remarkable for their sagacity. Newton, he said, would have dispersed his knowledge in a much wider field had he known less about figures. The married authors of this authentic life, Mr. and Mrs. Dickson, very properly, no doubt, dwell at much length on Edison's

qualities as an inventor, but the majority of the inventions credited to him are the half-forgotten or abandoned schemes of other men brought to a successful issue by the means, both pecuniary and technical, at his command.

The position which Edison fills in the popular mind is one of the most remarkable incidents in the history of invention. To many he is the embodied genius of electric lighting, and he is the popular conception of the greatest living scientist, but the fact is, that the lustre of America's real scientist has been paled by the glare and artificial glamour surrounding Edison and all his works. These distorted views have been to a great extent fostered by ingenious mechanical contrivances, such as the phonograph and other novelties, which are above all things amusing. It would be idle for us to say that he has done nothing of note; he is undoubtedly a clever man, but there are many who are better electricians, and more who are better mechanics. His ability lies rather in organising the work of a staff of trained experts, which, in its way, is unequalled. Edison has allied with his mechanical skill men of remarkable business aptitude. It is this combination of talents which has doubtless raised him above the majority of men. There are men possessing greater skill in mechanics, and men with greater commercial gifts, but the two are seldom combined. We are not called upon to analyse his extraordinary popularity. He doubtless has deserved it. But a moderate estimate would be that he is a practical, shrewd man, with (what we believe is too generally underrated) immense physical endurance, and, consequently, with infinite capacity for work, and an untiring energy.

CATHODE RAYS.

M. Poincaré describes, in the current number of the *Revue Generale des Sciences*, some interesting investigations recently carried out by M. Lenard on the properties of the cathode rays in vacuum tubes. Crookes, in his beautiful experiments with the electrical discharge in vacuum tubes, found that when the pressure was very small, the negative electrode was surrounded by a space almost completely dark. In this space, however, rays were found to exist, capable of impressing photographic media, of rendering phosphorescent bodies luminous, and of producing various calorific and mechanical effects; these were the cathode rays.

The properties of these rays have been investigated by Hittorf, Goldstein, Hertz, Ebert and Wiedemann, &c., and various theories have been proposed to explain them. Puluj, for example, imagined that they consisted of particles mechanically detached from the electrode; but this theory was experimentally shown by Crookes to be false. The theory proposed by Crookes himself was the well known hypothesis of radiant matter, according to which, the rays consisted of molecules of the gas, whose free path had been enormously extended by the rarefaction of the gas.

These recent experiments of M. Lenard, in the opinion of Poincaré, not only give the death blow to Crookes's hypothesis, but also throw considerable doubt on the validity of the kinetic theory of gases. The fundamental idea in M. Lenard's experiments was to ascertain whether the cathode rays would propagate themselves in media different from those in which they were generated. It is well known that these rays can only be generated in highly rarefied media, and under conditions completely determined by Crookes. But once produced, the question was whether they could be propagated in a gas at ordinary pressure or in an absolute vacuum. As these rays are intercepted by glass, it appeared almost impossible that means could be devised of allowing them to pass from a gas at one pressure into one at a different pressure. This difficulty was, however, overcome by the ingenuity of M. Lenard. Taking advantage of an experiment of Hertz, in which he had shown that very thin metallic plates are transparent to the cathode rays, Lenard set about discovering a metal foil sufficiently impermeable and resistant to the air, and yet transparent to the cathode rays. A plate of aluminium, from ·002 to ·003 mm. in thickness, was found to fulfil the required conditions.

If a Geissler tube is taken, having one extremity hermetically sealed by a metal plate, with a diametral slit of 1 to 2 mm. in width, which is covered by the aluminium foil, it can soon be ascertained that the rays traverse the thin foil, and *leave the Geissler tube*. This result is of the first importance; the cathode rays *can propagate themselves in air at the ordinary pressure*, and also, it can be shown, in the same way, that they *can propagate themselves in an absolute vacuum*. Here the hypothesis of radiant matter is entirely at fault; the experiment necessarily leads to the conclusion that the phenomenon takes place in the ether.

Many interesting questions are raised by these curious results. Why do the rays pass through the aluminium foil while they are stopped by the glass? Is it because of the difference between conductors and dielectrics? It can easily be ascertained that the thinness of the plate is the only essential condition; conductors and dielectrics behave exactly alike, provided they are of sufficient thinness.

The rays are not very distinctly visible in air or gas, especially if they are rarefied, and it is difficult to follow their path with certainty by the eye; but fortunately they can be made more visible by their action on phosphorescent substances, or their course can be determined by their photographic effect. In the apparatus of Lenard, the vacuum tube was surrounded by a metallic case to screen off electric forces, and on the end opposite the aluminium covered slit, a dark slide was fitted to obtain a record of the bundle of emitted rays.

The rays do not propagate themselves in a straight line; they turn round opaque bodies. This is a very important fact.

Gases, even when rarefied, are, for the rays, disturbing media. To study the propagation of the rays, M. Lenard examined the shadow thrown by a small screen of mica on a phosphorescent screen. It was soon ascertained that as the bundle of rays progressed in the disturbed medium, more and more rays were deflected from the straight line. The deflected rays were partly absorbed by the gas, and the more disturbed the medium was, the more absorbent it became. It was possible with the apparatus to measure the degree of permeability of different gases at different pressures. Air, for example, at 760 mm. pressure, in one experiment was penetrated to a maximum distance of 2·35 cm., at 0·019 mm. it was penetrated to a thickness of 140 cm.; hydrogen, at 760 mm., was penetrated to 10·6 cm. only, but at 0·164 mm. to 1·0 cm. These results show how considerable the absorption may become, and how the absorption in all gases tends to become equal at low pressures. It is possible also, by examining the luminous projection of the circular opening

of a screen, to measure the degree of disturbance of the different gaseous media. The result is remarkable; if the different media are arranged in decreasing order of disturbance, they will be found to be arranged in the order of their densities. The unique property of a gaseous medium which determines the degree of its disturbance is its density. The nature of the gas is of no importance; equal masses produce equal disturbances.

Hertz was the first to observe that there exist cathode rays of different kinds which correspond to luminous rays of different colours, and which differ in their capacity for phosphorescence and absorption. The experiments of M. Lenard fully confirm this observation. The cathode rays change when the pressure of the tube producing them changes; their properties are no longer identical. For instance, the rays produced at less rarefactions are less diffused than those produced at greater rarefactions, when they are afterwards propagated in the same medium.

Lastly, the very curious action of the magnet on the cathode rays is alluded to. A magnetic field even though very weak, strongly deflects the rays. The deviation is variable with the strength of the field, but the conditions being equal, with the same field the deviation of a beam is the same in all gases and under all pressures. This important fact shows that the deviation can only be due to the magnetic deformation of the ether. It is also very remarkable that the deviation is different for different rays (produced at different degrees of rarefaction); if we suppose they are, so to speak, different colours, the magnet acts as the prism which separates and disperses the colours.

M. Hess has proposed to utilise the deflection of the cathode rays in the magnetic field to register photographically rapidly varying currents. But Poincaré considers these experiments have a still greater importance from a theoretical than from a practical point of view. He considers that Crookes's theory of radiant matter fails to explain these new phenomena, and is no longer tenable. Moreover, a serious blow is dealt at the kinetic theory of gases; this theory no longer accounts for all the facts, and the day may not be far distant when it will have to give place to other views of the constitution of gases.

What idea, then, are we to form of these cathode rays? It can be no longer doubted that the phenomenon is one which is due to the luminiferous ether. It is very remarkable that the disturbance which the molecules produces depends on their mass alone. There is nothing corresponding to this with ordinary light. Many interesting questions remain yet to be answered. Why can the rays be produced only in rarefied gas? Why under conditions so different from those under which they may be propagated? What is the state of tension of the ether inside and outside the producing apparatus? The solution of these questions will be of the greatest interest. One cannot help thinking that these questions touch the inner mechanism of luminous and electric phenomena, and it is not too much to hope that here will be found the point of view from which a better comprehension of these phenomena may be attained.

Symbols and Abbreviations.

We are quite at a loss to understand why the *New York Electrical World* should, in an article with the above heading published in its issue of October 13th, characterise Professor Jamieson as "an unfriendly critic with a rival system." We are quite certain that his strictures on the recommendations of the Committee on Notation, which we published alongside these recommendations in our issue of September 21st, were conceived in no unfriendly spirit, and that nothing unfriendly was meant by him, who has the furtherance of the object sought after as much at heart as any man we know. Regarding his having a "rival system," that surely is a very wrong and paltry way of looking at the matter. Our correspondent is a man who holds strong and decided opinions upon certain subjects, and naturally claims and exercises the right to express and to advocate his views, so long as it is open to him to do so. That he is still quite within his rights in criticising the proposed scheme is apparent from the following quotation from our American contemporary, which appeared in the issue of September 2nd, 1893:—"The table of symbols and abbreviations recommended by the sub-committee of the delegates and received by the chamber of delegates, *without, however, being adopted by them*, is, with few changes, like the original proposition of M. Hospitalier, and published in the *Electrical World* of June 10th, 1893." This shows that the whole thing is merely tentative; else, why was it not adopted by the Congress and recommended by them for adoption as an international table? It is just possible, however, that it is because our correspondent disagrees more with the personal recommendations of the *Electrical World*, and of M. Hospitalier, than with the international ones, that our contemporary unkindly describes him as "unfriendly." If the recommendations were really international in the proper sense of the term, there would be much more likelihood of their immediate adoption. In any such system there must be a great deal of give and take—the sinking of mere personal inclinations before the will or usages of the majority. But, in order to merit such give and take, the body which draws up such recommendations must fulfil three conditions: (1) It must be composed of experts; (2) it must be truly international; and (3), it ought to give the fullest scope for discussion and the expression of diverse opinions. With regard to the first condition, there was only one man, or at most two, in the whole committee who had really studied the subject. With regard to the second, was it really international? Is it not the case that this country was represented at the discussion by only one man, and he of foreign birth? And with regard to the third, were any steps whatever taken to throw the meetings open, or to obtain the views of those who were best entitled to express them? As our contemporary has very justly remarked, "Only delegates and a few invited guests were admitted to the sessions, which, in our opinion, was a most unfortunate feature, as the countries will probably never know how efficient or inefficient their delegates were." In fact, the whole thing seems to have been got up without due preparation and certainly without adequate realisation of the importance of the issues involved.

Regulation of Pressure on Supply Mains.

Quite recently we had occasion to refer to the blinking of lights on public supply systems due to sudden switching on or off of large currents, but we had no idea that some circuits were so hyper-sensitive as some central station managers confess by their regulations. We have recently heard of cases where 50-ampère lamps were not allowed to be connected to the mains without a resistance switch limiting the starting current to 10 ampères and gradually increasing. We have no fault to find with such requirements, but there must be something radically wrong with the engineering of a large public scheme of supply when an insignificant 50 ampères can upset it. We can quite understand a variation of 50 horse-power, or more, disturbing a circuit of a total capacity of 200 or 300 horse-power, but 50 ampères is a pitiful confession, and that on continuous current supply too! It would be interesting to get at the truth in central station experience in this country. At present it seems impossible to get anything but unimportant descriptions. Our American brethren freely discuss their difficulties and criticise each other's mistakes with mutual advantages; the same candid confessions would be good for the soul of the engineer on this side.

THE LIVERPOOL OVERHEAD RAILWAY.

(*Concluded from page* 494.)

On this question Mr. Greathead briefly sums up that on the London line an average of 33 E.H.P. is used per train, and at Liverpool 36½ E.H.P., so putting the two rival contractors very much on a par.

Naturally Mr. Aspinall, of the Lancashire and Yorkshire Railway, wished to compare electricity with steam, and was dissatisfied at the comparison of electrical cost with the cost of steam on the New York elevated. True, American engines may use 54 lbs. of coal per mile of 92-ton trains, but English suburban engines used only 16 lbs. (see Mr. Stroudley's paper of 10 years ago. N.B.—The total load would exceed 92 tons). Mr. Moss, however, states that the American trains weigh quite 110 tons loaded (? are 2,000-lb. tons meant), and the coal for all purposes to be 42 lbs. per mile, the best engines averaging only 30 lbs. Then the runs are very short in New York, and the curves, though few, are only such as can be got in round a street corner. At the same time neither the train mile rate nor the ton mile rate of either the Manhattan or Brooklyn elevated lines is as low as that of the Liverpool line, despite the enormous traffic of the two former. Even with the very doubtful expedient of reducing the items of coal and wages to one-half, a habit Americans seem to think themselves entitled to without any sufficient reason, the American costs still overtop the Liverpool, so that for a new undertaking Liverpool has done well.

Compared with several lines on the Continent, however, Dr. Preller does not find much praise. At Marseilles the motive department costs a little over 3d. per train mile; at Florence, with gradient of 1—12·5 and 1—20, and fuel at 30s., the cost is only 4d., while at Buda Pest and other places 4d. covers *all* working expenses, as against 13½d. at Liverpool. In fact, the ratio of working cost to income at Liverpool was 86 per cent., against 66 per cent. on the South London. We should think that this is due to the as yet light traffic. Bank holiday has shown what Liverpool could do in the way of traffic. It remains to increase the daily traffic nearer to the exceptional holiday rates. Dr. Preller also found fault with the motors as being too heavy for their power in the ratio of 116 lbs. to 72 lbs., as compared with the motors of the Heilmann engine by Brown, Boveri & Co.

Something was said as to English side doors and American end doors for rapidity of exit. The American end doors on the New York elevated are rendered possible by the fact that people have got into the way of entering at one end, and leaving by the other. Our own side doors—infinitely preferable to end doors for filling an empty train at a terminus, or unloading the same, are deprived of their advantages at intermediate stations, unless there is provided a platform for ingress, and another for egress. As things are, the speed for the whole train is reduced to that proper to the time allowance of the stoutest and most bebundled old lady at the far corner of any one possibly very crowded compartment, plus the loading time of a similar passenger. With double platforms, as at King William Street, the side door would leave the end door far behind in speed. The old lady question is, however, nearly eliminated at Liverpool, for the central passages give nimbler passengers a road to other doors.

Comparisons are proverbially odious; they are also generally unreliable where such terms as train and ton mile are employed. We have probably all laughed at Mr. Bates Dorsey's attempt to prove American engines doubly as efficient as English engines mechanically, because they earned more money. He entirely omitted from his mechanical argument all mechanical work in weight moved, for he based the mechanical efficiency of the engine upon the number of passengers without any reference to the dead-weight of the trains.

It seems to us that the bulk of all railway literature is equally useless. For an engineering paper—supposed to teach something mechanical—we do not want the cash cost of anything where it is a question of motive power. All we want is the weight and description of coal, the amount of feed water, and the total draw bar effort where it is to be had. For an electrical railroad mere indicator diagrams are rough and unreliable. A continuous indicator is needed to show the engine power with a time record, and results are wanted on this basis. Indeed, for electricians a dynamometer reading on the dynamo shaft is all that should be considered in general terms. The rest, which now enters into running costs in the form of cash, is subsidiary, and of interest merely as a detail, useful so far as it is of value to know the class of steam plant giving a particular result, but otherwise merely serving as a button by which some manufacturing engineer may hold a supposed scientific meeting to listen to a trade advertisement. In all computations of efficiency every detail stands, or should stand, alone. The boiler is given so many pounds of a fuel of given power, and delivers so much dry steam. The engine takes steam and delivers brake H.P. There is so much of this disappears, as shown by a brake on a dummy armature spindle, and so much more is lost in conversion electrically, and so on. But instead of this we allow the payments of passengers, having a small but uncertain ratio to the total load, to enter into calculations of engineering statistics and comparisons that are well enough in their proper place. Engineers must look to costs, of course, and Mr. Cottrell's statements as to the weekly cost of brushes is perfectly good and in place.

It is satisfactory, too, to hear of the excellent working of the electrical automatic signals. They had grown to such an efficiency that in two months of working they failed to go to danger only once in 212,000 times, and failed once in 2,000 times to go to safety, the causes of failure being chiefly mechanical.

Considerable weight should attach to Mr. Siemens's preference for separate locomotives over motor cars. At least, such preference should, we think, be carried into practice when the question of electricity comes to be dealt with by the Metropolitan Railway. As Mr. McDonnell points out, electricity is very suitable for the frequent service between Mansion House and Victoria, but hardly suitable for, and certainly, we would add, far less needful on, the lines to Ealing, Wimbledon, or Willesden. Now, with motor cars, it would be wasteful or inconvenient to have these arranged to be run by steam on the thin traffic outside routes. With electric motors all round the Inner Circle, the trains could easily be taken forward on the outside routes by steam, and for these trains, until they got off the electrical sections, two motors could be employed if the trains were heavier. There is always the greater cost in drivers' wages to be considered with light and frequent trains, and it might be perfectly feasible to employ a mixed system, separate motors for trains to run out and motor cars for the circle trains.

As regards the question of motor cars or independent motors at Liverpool, the advantage seems to be with the car, the train when loaded weighing 752 lbs. per passenger, and on the South London line the weight being 871 lbs.

On the City and South London line there appears an excessive wage expenditure in the shape of the conductor at each end platform that is not warranted. We have often wondered why there could not have been side doors, with sliding opening movement in place of hinges, to save all the lost length of the end platforms.

Taken as a whole, there can be little doubt as to the mechanical success that has attended the Liverpool line. Probably very little extra expense will attend even a large growth of traffic, the coal per train mile having been found to decrease about 33 per cent. as between April and August, 1893, during which latter month the mileage was 21 per cent. greater, a notable fact, showing the economy of a more steady load made up of more frequent trains. The fuel per kilowatt-hour also falls from 8·40 to 5·81, as between about 70 and 119,000 kw. generated.

Altogether, the railway is a credit to its constructors, its working has been good, it is pleasant to use, and is a neat and sightly piece of work. It is to be hoped that its directors will continue to pursue a uniform policy in studying the public convenience, and not fall into the errors of the South London management, who never seem to know what to charge. The public, at least, never know what they may have to pay, or how long they may have to wait for the elevators to take them down. When the success of the Liverpool line is so patent, is it not a matter for wonder that a similar line — carried, however, upon a single line of columns—is not run from the old pump at Aldgate down the centre of the Mile End Road as far as Bromley Church? There is no better route than this in London. The road is wide, there is room for stations, and the amount of traffic for 18 hours daily is very large and steady.

STANDARD UNITS FOR ELECTRICAL MEASUREMENT.

(*Continued from page* 474.)

V.

In a previous article we gave a view of the standards laboratory, which did not, however, show the standards, being taken from a point that did not bring them within the field of vision. As we have described the current standard and auxiliary balance, a view of that portion of the laboratory in which these are situated is now given, from which a very good idea of their general appearance and location can be gained. The current standard is shown in the centre of fig. 9, with its pier and accessory details, while to the right the auxiliary one-ampère balance is placed, being coupled in series with the standard by means of the leads dropping from the ceiling to each instrument. The reversing switch for the latter is secured to the lower platform on the side opposite to that seen in the illustration, and the observer would therefore face the instrument from the far side. The front of the auxiliary balance looks towards the standard, so that, if necessary, one observer could inspect both instruments with little difficulty.

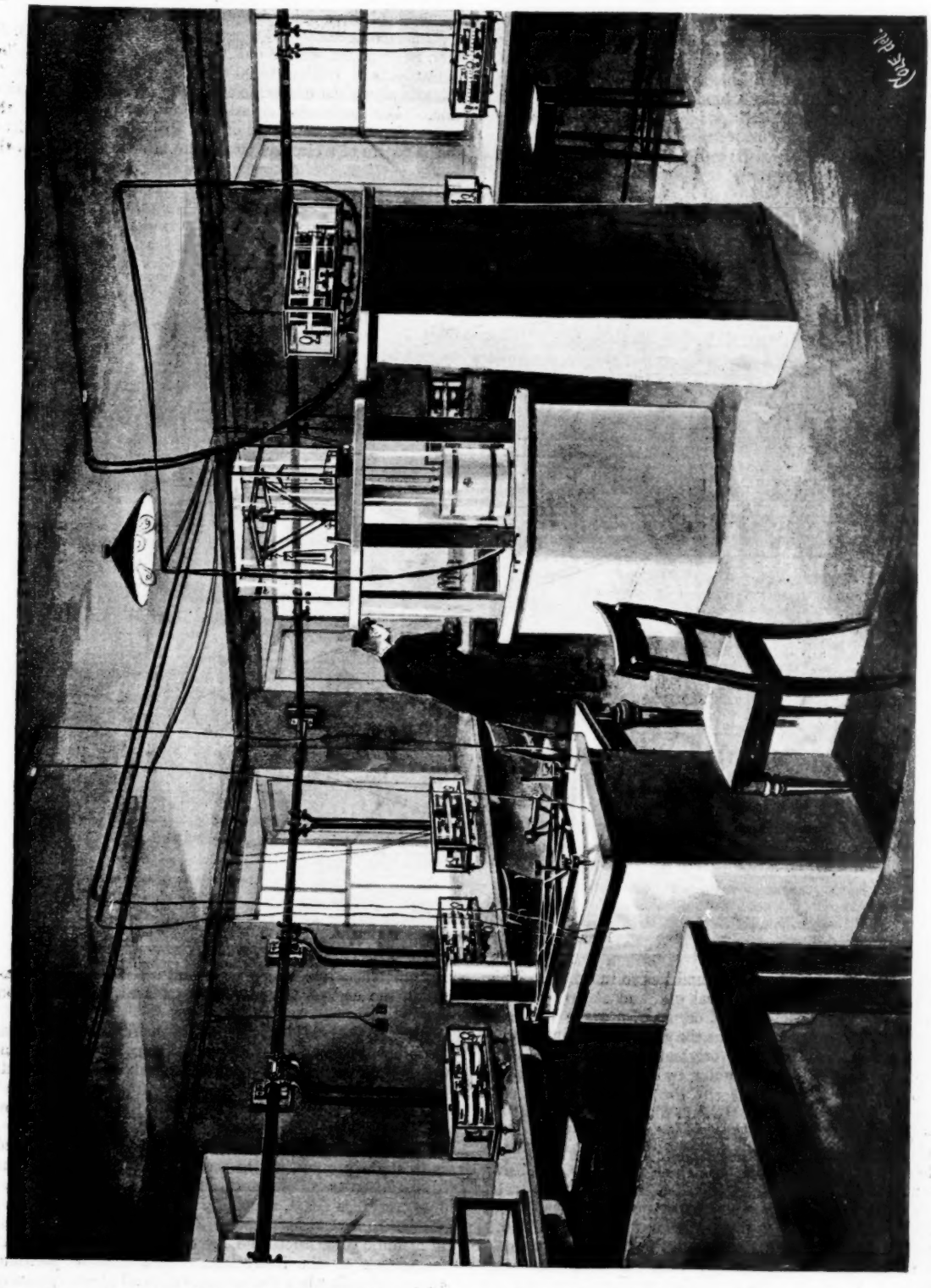


Fig. 9.—Pressure and Current Standards.

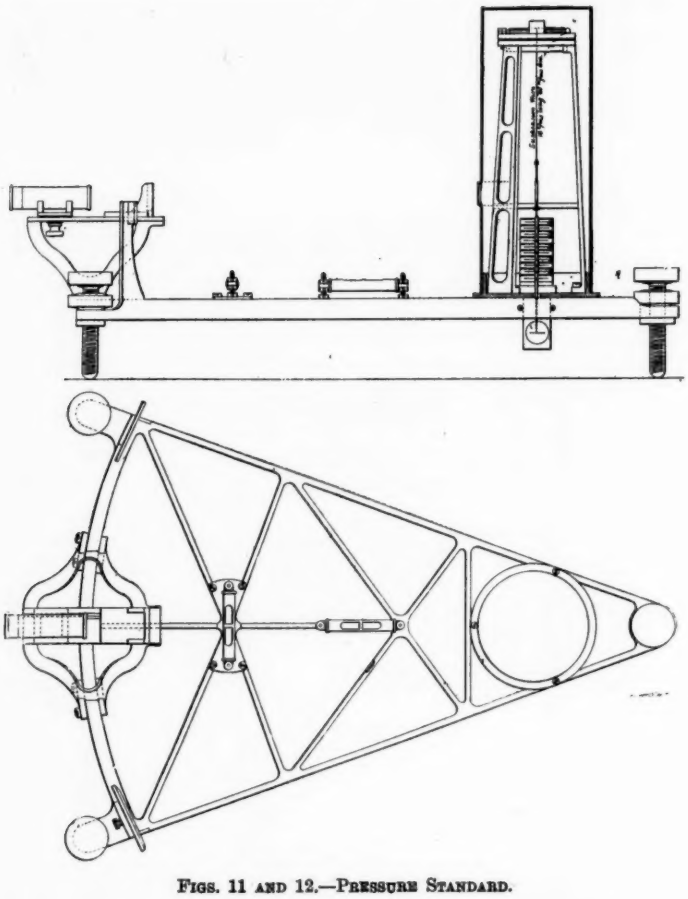
On the shelf running round the room are the Kelvin balances, giving multiples or submultiples of the ampère. These include a series of balances, capable of measuring from $\frac{1}{10}$th to 12,000 ampères, while for measurements which need not be correct to more than $\frac{1}{4}$ per cent., two Siemens's dynamometers have been provided, giving a range of from 3 ampères to 500 ampères. Both are available for alternating current work, and have been found to be reliable for the purpose intended, although they require to be carefully watched for zero changes, and the current electrodes have been arranged to produce no external electro-magnetic action, as the instruments are very sensitive to an effect of this kind.

One effect which has been noticed with the Kelvin balances is worth mentioning. An objection has been urged against the suitability of the Kelvin balance for practical work on account of the delicacy of the ligamentary suspension. The idea was that it would stretch and prove troublesome in many ways. It has been found that a stretching of the ligament has taken place in all the balances in the Board of Trade Laboratory, being considerable in some cases and less so in others. This trouble is by no means a general one, and at first it was a question why this effect should occur with these balances. The probable explanation is that the ground all about Whitehall is known to have been originally a morass, and even now one can get at Thames water by digging to a very few feet below the present surface of the ground—ten feet suffices at Richmond Terrace. It is possible that there may be an elastic vibration of the house as a whole due to this, which accentuates a stretching of the suspension.

Referring to fig. 9 again, the main conductor for heavy currents, from which drop branches are taken to the balances, will be seen, and also the potential or pressure circuit from which branches are taken off at intervals to pairs of terminals on the walls. These two circuits give the current and pressure supply for testing energy, wattmeters or watt-hour meters, and we shall have something to say regarding their arrangement later.

On the right of the same illustration the pressure standard will be seen mounted on its pier and arranged as it is in practice. A perspective view of the instrument is given in fig. 10 with the cover off so as to exhibit the construction of the principal parts. The instrument is also shown in plan and sectional elevation, in figs. 11 and 12. It consists of an arrangement of ten parallel suspended vanes shaped like the moving part of the Thomson quadrant electrometer fitted on an axis passing through the centre of gravity of each vane and separated by distance pieces to a distance of 9 mm. apart. On the same axis is fixed the aluminium frame of a concave mirror, 19 mm. in diameter, and about 61 mm. focal length, which is held in the frame by means of three light phosphor bronze springs.

This arrangement is suspended by means of a wire, 0·05 mm. in diameter, and 18 cms. in length, formed of an alloy of 10 parts of iridium to 90 parts of platinum attached to the axis above the mirror, so that the axis hangs in a vertical line. For horizontal adjustment of the position of the vanes, the upper extremity of the suspending wire is fixed to the centre of a circular brass plate having teeth cut in the circumference into which a tangent screw is geared so as to enable the end of the wire to be rotated in the horizontal plane.



Figs. 11 and 12.—Pressure Standard.

The vertical adjustment of the position of the vanes accomplished by the raising or lowering of the platform on which the circular brass plate mentioned above is pivoted by means of three screws for raising and three for lowering. These screws regulate the distance of the platform above a similar platform fixed by means of three supports to the framework of the instrument. The vanes are suspended so as to slightly enter, at the zero position of the instrument, between two sets of eleven thin polished brass plates shaped as quadrants of a circle, which are fixed horizontally above one another to a vertical support. These two sets of plates are in metallic connection and are carefully insulated from the framework of the instrument. The relative position of vanes and cells when the instrument is all at one potential is shown in the sketch plan of the electrometer box, fig. 13.

In order to reduce the vibration of the suspended system, and the time which must elapse before an accurate observa-

tion can be taken, a thin horizontal brass disc is suspended in refined mineral oil, contained within a glass vessel, by means of a wire attached to the lower portion of the axis of suspension of the vanes.

The suspended system and quadrants with their supports are enclosed in a brass case, having in front of the mirror a rectangular window of parallel worked glass. A hole is cut in this case for the insertion of a key fitting the squared arbor of the tangent screw. The terminals, by means of which connection is obtained with the vanes and quadrants, are fixed on a thick piece of polished ebonite projecting beyond the brass cover.

One terminal is in connection with the metal framework, the other is entirely insulated, and a tongue of brass forms a switch, which is connected by means of a brass rod with the two sets of quadrants can be turned so as to make contact either with the insulated or with the uninsulated terminal.

The arrangement forming the electrical portion of the instrument is mounted near the apex of a framework of brass in the form of a circular arc, which rests by means of three feet on a horizontal slab of polished marble supported on a large block of Portland stone on a concrete foundation. A screw thread is cut in the feet for accurate levelling of the framework to which two spirit levels are attached. On a support attached to the centre of the curved portion of the framework is fixed the

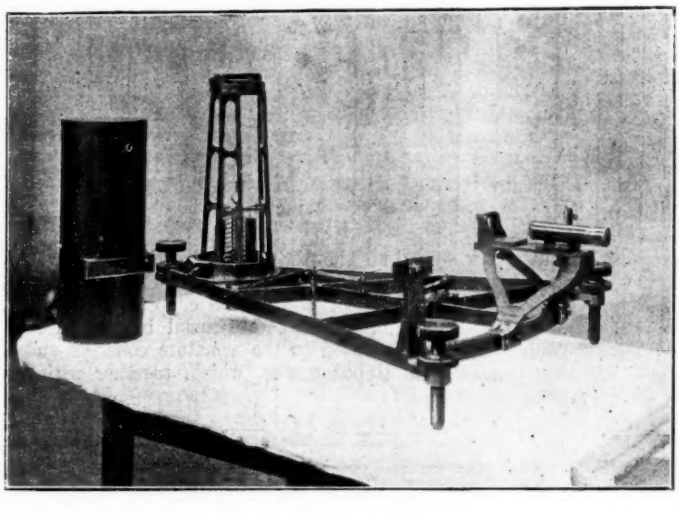


Fig. 10.—Pressure Standard.

observing portion, consisting of a magnifying eye-piece, or telescope, in front, and in the focus of which is stretched a vertical copper wire 0·06 mm. in diameter. At each end of the arc is erected a vertical support, to which is fixed a tablet of brass, with the surface facing towards the mirror platinised. On each of these faces is engraved a vertical line. The lines form the fiducial marks, that on the left of the observer giving the zero position and that on the right the correct position for 110 volts difference of potential between the terminals.

The distances from the mirror of these tablets, and of the sighting wire, is adjusted so that the image of the wire on the tablet, when the mirror is at the proper angle, coincides with the sighting wire. In using the instrument it must be in accurate adjustment as regards level and the position of the suspended system. The vertical adjustment of the latter is obtained by trial. The vanes should be at equal distances from the quadrants above and below, this position giving minimum sensibility. When this condition is not complied with under all temperature variations permissible, the curve of an instrument graduated throughout the scale ceases to be a straight line, as will be shown later. The horizontal adjustment of the suspended system is obtained when the image of the zero fiducial mark produced by the mirror exactly coincides with the sighting wire, the switch being turned so as to connect the quadrants with the metal framework of the instrument.

The levelling of the framework and vertical adjustment of the suspended portion of the instrument were carefully attended to when the instrument was first set up in the standards laboratory, and these adjustments have since that time remained constant. The horizontal adjustment of the suspended system requires occasional attention from time to time. Arrangements are made in taking pressure measurements by which a pressure which can be continuously varied from about 98 to 102 volts when actually using the instrument is obtained. This pressure is applied to the 100-volt standard and to the instrument or instruments to be compared with it, and is adjusted until the image of the fiducial mark indicating 100 volts exactly coincides with the sighting wire by observation through the eye-piece. The coincidence is maintained by adjustment of the pressure if necessary until the expiration of five minutes from the time of first applying the pressure, when, if there is no visible vibration of the mirror, the pressure is exactly 100 volts. The international standard of pressure, the volt, is then obtained by taking one hundredth part of the pressure so measured.

As has been shown, the pressure standard is an electrostatic instrument used idiostatically. To prevent any purely electrostatic and external influence interfering with the measurements, the Cardew instruments used for low pressure approximate tests and shown on the right of fig. 1 (page 389 *ante*), are coupled in parallel with the standard so as to cause a current to flow in the circuit to which the pressure instru-

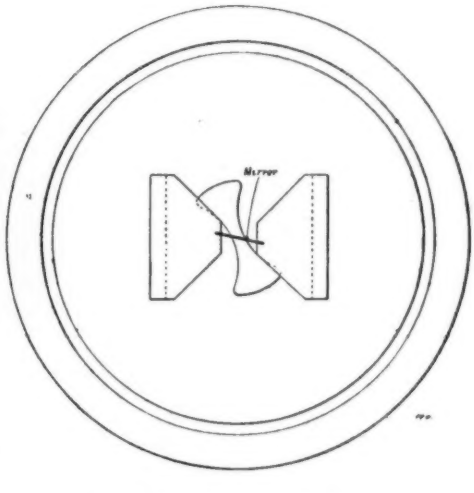


Fig. 13.—Vanes and Cells of Pressure Standard.

ments are connected. The terminals of the pressure instruments are connected to one of the connecting leads in the inverse order to which they are connected to the other, so that the difference of potential between the terminals of any number of instruments in parallel on the testing circuit must have a uniform value. The variation which would otherwise be caused by a drop in pressure between the instruments due to the leads connecting one with the other is compensated for in this way.

"DRY CELL" MEDICAL BATTERIES.

The illustration, which we have taken from the *Scientific American*, represents a new form of "dry cell" faradic battery, placed on the market by Queen & Co. (Inc.), of Philadelphia. This type is specially adapted for home use (preferably under the advice of a physician), and is extremely compact, convenient to handle, and durable, thus being admirably suited for carrying about when travelling. The cells are sealed, so that there is no leakage of acids, as in older forms, and the battery is perfectly clean and "nice."

Three sizes are made, all mounted in handsome mahogany boxes. Size No. 1 contains two cells, and will produce a current stronger than most people can endure, which, how-

ever, can be graded down so as to be imperceptible to the most sensitive nature. The change is effected gradually, by sliding the secondary coil on and off the primary. A special switch shuts current off entirely when the case lid is closed. Size No. 2 is larger than the preceding, and contains four dry cells instead of two. There is also a difference in the method of current regulation, which in this style is accomplished by a switch "controller." Battery No. 3, or Physician's Battery No. 1, is the largest of the series, and is amply sufficient for

the requirements of most doctors who want a compact and portable apparatus. The cell block contains six cells, which produce a very powerful current. Samples of the batteries were exhibited at the World's Fair, and received the highest award for "compactness, range of action, efficiency, and beauty of workmanship." The examining judge was Dr. W. J. Herdmann, of Ann Arbor, Mich. When the cells in any of the above become exhausted (which occurs only after long service), they can readily be renewed at a slight expense by sending the containing block to the makers.

THE PLANET ELECTRIC LANTERN LAMP.

This lamp is an excellent design of an automatic arc lamp fed by screw and motor gear. It is not an entire novelty in arc lamp mechanism, but has many points of interest, especially at the present moment, when music hall and theatre licensing authorities are insisting upon the adoption of the electric light not only for illumination, but for scenic effects in these places. For such purposes a thoroughly good automatic lamp is an absolute necessity. We illustrated and described one—the "Krueger lamp"—recently, also designed for this purpose.

A lamp for lantern purposes must be simple and reliable, and be capable of working in the most unskilled hands, and, most important of all, should have no loose parts to dangle about when the lamp is inclined; in fact, the mechanism should work equally well whether it stands upright, is inclined to any angle, or laid on its side.

The Planet lantern lamp appears to meet these requirements, so far as a continuous current lamp is concerned, but we are not informed whether the lamp can be used for alternating currents or not.

The accompanying illustrations show the various parts of the lamp in detail. In fig. 1 the lamp is shown partly in section, with one field magnet removed, and fig. 2 shows a diagram of construction and connections.

Corresponding parts in both drawings are indicated by the same letters. C + and C — are the positive and negative carbons; these are proportioned so as to burn at an equal rate. The carbon holders, H and H¹, are arranged to be moved in either direction by the screwed shaft, K, by means of the threaded collars or nuts, N and N¹. The upper and lower portions of the shaft, K, are threaded right and left hand respectively, so that the two carbon holders always move in opposite directions. The toothed wheel, W, is keyed on to the shaft, K, by the means of the pin and slot, P, which leaves the shaft free to move through a certain distance, in order to adjust the arc vertically to the focus, by moving both carbon holders simultaneously. This movement is effected by slackening the lock-nut, Q, and turning the milled nut, Q¹, in either direction, according as the arc is above or below the focus; this adjustment does away with the necessity of a separate levelling table. The armature, A, of the electric motor drives the wheel, W, by means of a small

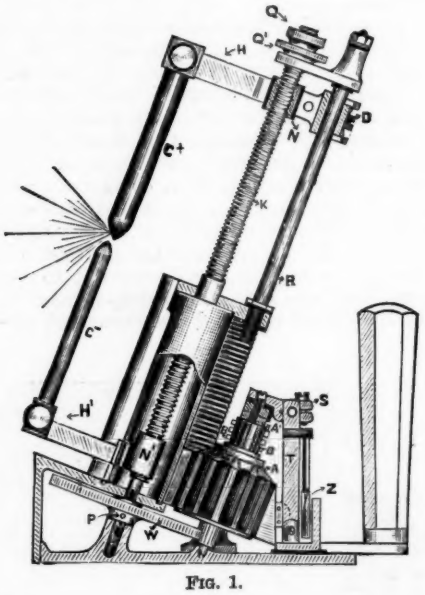


Fig. 1.

pinion. M and M¹ are the field magnets of the motor, wound with several layers of thick wire, through which the current flows to the + carbon by way of the copper guide rod, R, and sliding block, D. B and B¹ are metal brushes, through which current is conveyed to the armature coils. S and F are two platinum tipped screws, which, together with the

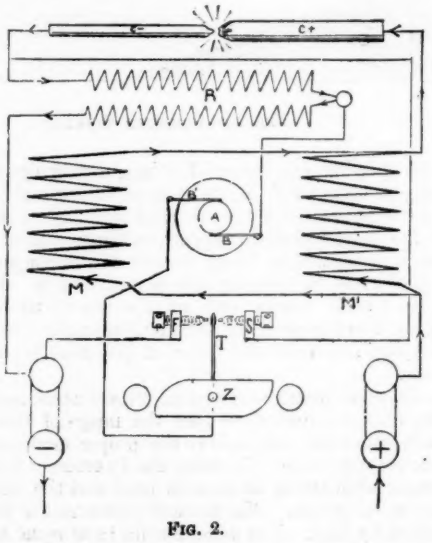


Fig. 2.

metal tongue, T, and the soft iron bar, Z, form the relay by which the supply of current to the armature is directed and controlled. By adjusting these two screws the length of arc can be regulated at will. When the tongue, T, touches the screw, F, a small current, derived from part of the resistance, R, passes through the armature, causing it to turn, so as to feed the carbons together; and when the tongue, T, touches the screw, S, the current is reversed, thereby reversing the direction of the armature, and separating the carbons.

Some hand fed lamps are used for scenic effects, but no

hand fed lamp can ever equal an automatic lamp with a positive feeding action and no loose parts.

This lamp is well made, and constructed on thoroughly good engineering principles of design.

THE DISEASES OF DYNAMOS.

(*Concluded from page* 497.)

III.

D 1 and 2.—Speed Irregularities.

D 1.—These can hardly be classed as diseases of dynamos; they are altogether due to bad engineering in most cases. If the speed of a dynamo is too low or too high, owing to governor or engine failing to regulate, the governor or engine must be rectified or substituted by one which will regulate.

Cause 43.—(*a*) A series motor runs too fast on constant current.

Remedy.—Shunt portion of current across the motor, or use a governor to regulate field current.

43.—(*b*) Series motor on constant pressure circuit.

Remedy.—Regulate by a resistance in series. The proper motor for working on constant pressure is a shunt motor which is self-regulating.

Cause 44.—Shunt motor speed irregular or too fast or too slow.

Remedy.—Get another motor properly built and wound for the work to be done and the pressure of the circuit. The use of a rheostat or regulator for a shunt motor is only required when such motors are to be used at variable speeds, but no such things are permissible on motors to run at nearly constant speed. A motor which slows down more than 5 or 6 per cent. between no load and full load is too small for its work; but, in testing motors for variation in speed due to load, be careful to find out how much of the fall in speed is due to fall in pressure in the leading wires by watching a voltmeter across the motor terminals.

D 2.—Speed too Low.

Cause 46.—Overload.

Remedy.—Measure current and pressure in and on motor; if current is greater than that allowed by maker, the load must be reduced until the current does not exceed maker's limit. The speed may be too low, owing to the motor being geared to its work by too low a gear.

Cause 47.—Short circuit in armature.

Remedy.—Search for short circuit by sending a large current through the armature only, and measure P.D. between each plate and its neighbour on the commutator; short-circuited coils will show no P.D.

Cause 48.—Striking or rubbing of armature.

Remedy.—Wires may be heaved up or loose, or armature not centred. See No. 35.

Cause 49.—Friction.

Remedy.—See B 3.

Cause 50.—Weak field.

Remedy.—A weak field does not lower the speed of a motor; its speed rises directly as the field weakens. The stronger a field is, the slower goes the armature; hence, to remedy a slow speed from this cause, weaken the field by inserting resistance in the field circuit only.

E 1.—Motor Stops.

Cause 51.—Great overload.

Remedy.—Examine load for any obstruction or excessive friction and remove. There is not likely to be any harm done to a series motor on constant current stopped by overload, but a shunt motor may have its armature burnt out unless a fuse is in circuit, and a fuse must always be kept in circuit of a shunt motor. Overload is not a dynamo disease at all, it is due either to accident or to ignorance, putting, say, five horse-power of work on a one-horse motor.

Cause 53.—Circuit open.

(*a*) Safety fuse blown.

Remedy.—This may be due to overload which must first be corrected and a new fuse of proper size then put in.

(*b*) Broken wire or connections.

Remedy.—Hunt out broken wire and repair, see No. 13.

(*c*) Brushes not in contact.

Remedy.—This is the most common cause of a stoppage in a motor; press brushes down by hand and motor starts off, showing brushes require feeding up to commutator.

(*d*) Switch open.

Remedy.—Adjust switch contacts to make good contact.

(*e*) Current cut off from mains. Must watch voltmeter to see when again turned on.

Cause 54.—(*a*) Complete short-circuit of field.

Remedy.—Test resistance of coils, faulty one will show much less resistance, must be rewound if internal fault, but fault may be at terminals of field coil, if so, re-insulate them.

55.—(*b*) Of armature.

Remedy.—May be short-circuited at brush-holders, or by copper dust, or by contact between commutator connectors; examine and test these points and remove contact.

E 3.—Motor Runs Backwards.

Remedy.—Reverse the connections of the field coils to the brushes, this fault is always due to current in field flowing in the wrong direction.

F.—Dynamo Fails to Generate.

Cause 58.—(*a*) Reversed magnetism in field. This sometimes happens through a reversed current having been sent through field coils in testing or by accident, it has happened through a lightning discharge. A weak field may sometimes be reversed by the earth's magnetism, and sometimes by neighbouring dynamos.

Remedy.—In all these cases a current in the right direction must be sent from another dynamo or a battery through the field coils to remagnetise; if the right direction is not known try first one way then the other.

(*b*) Reversed field connections.

Remedy.—Try reversing field connections. This starts a reversed dynamo in most cases.

Cause. 59.—Brushes not in right position or not making good contact.

Remedy.—Carefully examine and adjust brushes of any dynamo which fails to start before doing anything else; move brushes into best position by rocker.

Cause 60.—Short circuit in machine.

Remedy.—See No. 12, 54 and 55.

Cause 61.—Short circuit in circuit. This causes a shunt dynamo to fail to generate, while it assists a compound or series machine to generate too much, blowing the fuses.

Remedy.—Remove short circuit; generally in some lamp case or socket.

Cause 62.—Field coils opposed to each other; due to someone coupling up the coils to oppose each other.

Remedy.—Follow the current direction in windings, and connect up by any of the well-known electro-magnet rules so as to produce the N. S. poles in the dynamo; a compass needle is handy to discover the polarity.

Cause 63.—Open circuit. This is a fault easily discovered and remedied. It is not a dynamo disease, but a fault in the attendant, who should see to the completeness of the circuit. A switch may be left open, a wire loose in a terminal, or pulled off; a fuse may be blown, a brush out of contact, or some such fault, easily discovered and remedied.

64.—Too great a load.

Remedy.—This is practically the same as a short circuit in the external circuit, for which see 61. A shunt machine would fail to start, but a series machine or compound machine would blow out the fuse.

65.—Too much resistance in field regulator.

Remedy.—Reduce resistance until dynamo starts up, then increase it until normal voltage is obtained before switching in external circuit.

Note Appended to Lieut. Parkhurst's Sheet.

Never use ice or water to cool off bearings, as it may get into armature and ruin it, unless it has been made waterproof as in some cases of street-car motors.

Never shut down because of hot box until remedies 32, 28, 26 and 25 have been tried and proved useless. If absolutely necessary to shut down, get belt off as soon as possible, do not allow shaft to "stick" in stopping, get boxes or bearings

out and cool off naturally as soon as possible and not in water as this may ruin them, then scrape, fit, polish, clean shaft, and test for free turning by hand before belting up and starting again.

Cleanliness about dynamo or motor is imperative; dirt, oil, copper dust, may prove source of great annoyance or damage. Small tools, bolts, or pieces of iron must be kept away from dynamo as they may be drawn into, or fall upon armature and ruin it.

A Good Rule.—Never allow loose articles of any kind to be placed upon any portion of dynamo. Brass or copper oil cans are best to use, as they are non-magnetisable.

All connections must be large, clean, and firm. Look over and tighten loose connections, screws, or bolts daily.

Always keep copper brushes raised from commutator when dynamo is at rest. Poor cheap oil is poor economy; use none but the best of mineral oils. All new oil should always be filtered before using.

Oil from self-oiling bearing should be filtered before being used again.

Keep cotton waste off the commutator. Use canvas or cloth to wipe with.

A piece of pine makes a good burnisher to use on commutator to keep it clean and smooth.

In regard to the opening paragraph of this note, we would say that any dynamo or motor armature which will not stand water is too delicate for ordinary use. It is so easy to make armatures which will stand washing down with a hose-pipe without damage, nowadays, a low pressure dynamo which is not waterproof is not acceptable.

We have followed Lieut. Parkhurst's arrangement so far as we could in these paragraphs, passing over some causes and remedies as not of importance, while we have extended others to some extent.

It will be seen that, strictly speaking, the diseases peculiar to dynamos are few and simple, and mostly due to three causes—bad design, bad workmanship, and careless attendance. The other troubles arising from engines, governors, belts, oils, switches, external circuit faults, while well worth including in the list and suggesting remedies, are not dynamo troubles but faults common in all machinery. To people who have electric plants of their own, and to attendants, we believe the hints thrown out in these suggestions will be of considerable value.

ELECTRICAL (SO-CALLED) BODY APPLIANCES.*

By H. NEWMAN LAWRENCE, M.I.E.E.

Body appliances bearing such names as electric, magnetic, electro-this and magneto-that, and so on through all possible word combinations in which the word "electric" may be included or implied, are plentiful. The word can only be put so prominently forward because it is supposed to carry a definite meaning, and has been found to possess great attraction for the general public. This is an electric age, we are told, and it naturally follows that a large number of persons exist who blindly accept anything that is told them under the word "electric," and often thoughtlessly, but enthusiastically, adopt and promulgate views, statements, and appliances which outrage every known scientific law bearing upon the subject.

Physicians are, for the most part, well aware of this; are quite prepared to condemn these appliances on general grounds, and to warn their patients against the persons who sell them; but hardly so ready or able to give reasons for their condemnation, and to show *why* these things are of no use. Unless a physician can give good reason for his condemnation of electric body appliances, the fact that he does so condemn them is very apt to be taken as evidence of professional jealousy and narrow-mindedness; and his reputation and connection suffer in consequence.

It may therefore be well to here consider briefly the conditions under which these appliances are supposed to work, and to see how some recent scientific investigations assist us to form definite opinions thereon.

First, it may be said that a very large proportion of these so-called electric appliances are so badly constructed, or so marvellously connected, that they can not by any possible chance or mischance produce electric currents. Some bear their own condemnation upon their faces, for they are announced as *never wearing out*, and *never requiring renewal*.

The only way in which an electric appliance can benefit the body electrically is by *producing electrical energy capable of doing work* upon the body, in the same way that an electric bell outfit must produce electrical energy capable of doing work upon the bell—*i.e.*, make it ring. There must be a source of energy in the apparatus, and that source requires to be renewed from time to time as the energy produced by it becomes exhausted. In other words, we must have an electric battery, and the electric battery which will never wear out nor run down, as it is called, has yet to be discovered. Science says clearly and definitely that energy can not be created; it may be transformed, changed in character—as from chemical to electrical in the galvanic battery—but it cannot be obtained or created from nothing. Any electric appliance therefore which professes to *never* need electrical renewal is a *fraud*.

Let us take an illustration from the typical electro-magnetic appliance. We have one or two or more strips of magnetised steel sewn into garments or bands, and we are told that the presence of these magnets causes electrical currents to be set up in the body. Now, while it is quite true that electric currents may be produced in a conductor which is in proximity to a magnet, it is also true that in order to do this one of the two *must be moved* relatively to the other. Either the magnet must be moved relatively to the conductor, or the conductor be moved relatively to the magnet. Without such motion no current can be set up in the conductor. Were it otherwise there would be no need to employ large steam engines, or water motors, or to seek the power of Niagara Falls to drive dynamos for the production of large currents for electric light and power purposes. All that would be necessary would be to place magnets near the conducting wires, and then to draw off all the electrical energy required. The absurdity of such an idea is apparent to everyone, and yet when it is put forward in connection with body appliances many are willing to accept it without question or thought. The body, which is here supposed to be the conductor, when it moves carries the magnet or magnets with it, and there is no relative motion of either one to the other. There is no energy expended in the appliance, and consequently no possibility of any electric influence upon the body. It would be just as reasonable to place a hammer and a nail together, and expect the latter to be driven home without any movement of the former, *i.e.*, without any expenditure of energy.

While on the subject of electro-magnetism, it may be well to refer to the fact that magnetism alone has been said to influence the body. Against this assumption (in favour of which not one iota of physiological proof has ever been offered) we have the carefully carried out experiments of Kennelly and Peterson,* who, throughout a long series of tests, found not the slightest evidence of physiological action, even when their subjects were placed in very strong magnetic fields. Further, the startling claims of Dr. Luys, in Paris, as to the curative influence of magnets, were shown by Dr. Hart † to be based upon psychological effects alone, equally good results being obtained by dummy magnets of wood, &c. In fact, the *suggestion* was everything and the *fact* nothing.

Other appliances and devices are to be found which differ from the above only in the point that they do not claim magnetic action. They profess in some other way to do electrical work without any provision for the production of electrical energy, or they are said to act in some hitherto unknown manner, which even their vendors do not attempt to explain, but lead the public to suppose the action (*sic*) to be electric because they use the word electric or electro as a title. An apparatus of this latter type has recently had a large sale both in America and in England. Its vendors have never (so far as I know, and I have questioned them myself), attempted to explain the action claimed for it. Nor

* From the New York *Medical Journal*.

* New York *Medical Journal*, December 31st, 1892.
† *Popular Science Monthly*.

can they, for the whole idea is an outrage upon the well-known and oft-proved laws of physics and physiology. Yet this thing is sold freely at more than a hundred times the cost of its materials, and some people who claim to be apostles of light and leading do not hesitate to openly praise and recommend it.

I will pass on to those devices which are, perhaps, even more difficult to deal with because there is a germ of truth in them. I mean those appliances which are capable of producing electrical manifestations under certain conditions. Now, what are the conditions under which electricity may influence the body, *i.e.*, do work upon it? Physiologists tell us that the properties of galvanic or continuous electric currents which can influence the body structures are the electrolytic, the thermal, and the cataphoric—electrolytic, by means of which the fluids of the body are decomposed or broken up into their constituent parts; thermal, by means of which the temperature is raised either locally or generally; and cataphoric, by means of which substances in solution are passed without chemical change from one part of the circuit to another. To produce these effects we must have a current which *can pass* through the body, or that portion of it which it is intended to influence. The body offers considerable resistance to the flow of an electric current, and consequently any current must possess a proportionate amount of electric pressure, or electromotive force, as it is called, before it can overcome that resistance, pass into, and do work upon the body. The state of affairs is somewhat similar to that under which a bullet, when simply pressed or thrown against a door, fails to pass through it, but when fired from a pistol, by reason of its velocity or pressure, not only passes through, but is capable of doing work on the other side. Going a step further, we may point out that supposing the door to be very thick or have iron sheeting over it, an ordinary pistol would fail to pierce it, but that a bullet from a more powerful gun would easily succeed. For electrical purposes the body may be said to be protected by a semi-proof sheeting (the skin), which can only be penetrated by currents possessing considerable pressure on account of the resistance it offers. It would occupy too much time and space to go fully into the consideration of the resistance of the human body. Many authorities have found the value of this resistance under various conditions, but until quite recently no measurements taken *under belt conditions* had been recorded. Those who have never tried such measurements cannot fail to be astonished at the high resistance of the body under these circumstances. "A short time ago I measured it on several people, using for the purpose a belt which had just been purchased at one of the large London establishments for the sale of such commodities. The average resistance was 800,000 ohms. As this particular belt had rather small discs, I will assume that the figure may be less with others whose contact discs are larger or differently arranged. Let us be charitable and call it a half—*i.e.*, 400,000 ohms. . . . To pass even a tenth part of 1 milliampère through such resistance requires (by Ohm's law) 40 volts, and this is at least 40 times more than the best of such belts is capable of." * This view of the resistance of the body under belt conditions has been also proved by Dr. W. S. Hedley,† and by expert evidence given at the famous Harness belt trials which occupied the English law courts at intervals during the autumn of 1892 and spring of 1893.‡

Such being the resistance, let us see how we arrive at the conclusion that 40 volts is forty times more than such belts are capable of producing. Every belt which depends upon the moisture of the body for its action cannot produce a higher electromotive force—electric pressure—than that of one couple of the elements of which it is composed, because all the elements dip into the same electrolyte (the body moisture), and cannot therefore be connected in series. There may be many elements, but the fluid of the body cannot be separated off into cells. It is all in one containing vessel, so to speak, and the only effect of increasing the number of the couples is to practically increase the size of the plates of *similar* metal. As electromotive force depends only upon the electrical *difference* between the metals used in the same exciting fluid or electrolyte, it follows that the total electromotive force of these couples, be they few or many, is only that of one couple. The couples used in these belts are nearly always copper and zinc, and their maximum electromotive force in the presence of such fluids as body moisture is *less than* 1 *volt*.* Other couples may give a slightly different result, but no combination has yet been found which, with such an excitant, will give over 1 volt.

So far, then, we have an arrangement which may give one volt, and which has to act upon a resistance of 400,000 ohms. This, by Ohm's law, will give a possible current through the body of *one-fourth of a thousandth part* of 1 milliampère—an infinitesimal fraction of the smallest current (1 milliampère) recognised by electro-therapists; too small for the conception of any but the theoretical mathematician, and less than may be obtained by dipping a needle and a pin into a spot of ink.†

The belt vendors are now trying somewhat to trim their sails to the wind, and declare that their devices are only intended to generate small currents, and that their infinitesimal possibilities may prove useful to the body if the *time* factor is taken into account; that a small electrical influence applied for a long time is equivalent to a greater influence applied for a proportionately shorter time. Imagine having to wear a belt 4,000 hours (nearly six months) before the effect of even 1 milliampère-hour could be obtained!

Recent discoveries have, however, given us (if possible) a stronger and simpler answer to these absurd claims. We have seen that one of the most important properties of the electric current which influences the body is the electrolytic. To produce electrolysis in any fluid requires at least a minimum electromotive force. This minimum varies in different fluids and semi-fluids, and has recently been determined both by calculation and experiment to be for chloride of sodium, calculated, 2·02 volts; determined by experiment, 2·10 volts;‡ let us say, in round figures, 2 volts.

We have proved that belts which depend upon the moisture of the body cannot generate more than 1 volt. For electrolytic purposes various authorities agree that the fluids of the body are equivalent to a 2 per cent. solution of sodium chloride.§ Sodium chloride, as we have just seen, requires at least 2 volts to electrolyse it. Therefore it is impossible for these belts to produce electrolysis in the human body.

Thus, both as regards electromotive force and quantity of current, these belts stand condemned as useless. Of course, many testimonials vouching for the curative value of these and other body appliances equally impossible are to be met with, and some at least of them are genuine expressions of the belief of those who wrote them. Anyone who observes human nature knows something of the enormous influence of mind over body; it is almost impossible to set a limit to it; but because mind influence occasionally brings about some startling cure, under cover of the use of some appliance which is absolutely incapable of producing any physical or physiological effect upon the body, it by no means follows that the appliance ought, therefore, to be called curative. It is simply an evidence of the psychological influence and of the same nature of things as the monastic miracles of the middle ages. Psychology is quite outside our present investigation, and it affects all other remedies, and supposed remedies, as well as electricity. My point is that because people sometimes blindly believe what they are told, it is not, therefore, right to wilfully tell them lies, and it is a very low kind of fraud which squeezes one hundred times the value of an appliance out of the public simply and solely because the appliance is called by a name to which it has not the slightest right.

I wish to point out that the strictures upon belts made above mainly refer to those which depend upon the moisture of the body for their action—*i.e.*, are not in any way complete batteries apart from the body. Nearly all the so-called electric belts are of this type. I have, however, seen in England (it may exist over here, but I have not yet met it), one body appliance which is a genuine battery and will act as such apart from the body, having all the essential parts self-contained. It will electrolyse sodium chloride, and it will

* Article by the author in Electrical Review, London, 1892.
† *Provincial Medical Journal.*
‡ Electrical Review.

* Electrical Review.
† *Ibid.*
‡ *Comptes Rendus*, Vol. cxviii., No. 4, p. 189. Article by C. Nourrisson.
§ Beard and Rockwell, W. J. Morton.

pass a perceptible current through the body. Therefore it is a genuine electrical appliance, and is exempt from the above strictures, though for various other reasons its value as a therapeutic agent is open to much question.

34, West Nineteenth Street, *June* 12th, 1894.

ECONOMY OF POWER-HOUSE OPERATION.

Mr. Craven treated this question in a paper read before the twelfth annual meeting of the New York State Association, giving special attention to the generation of steam. He agrees that improper firing is the great cause of loss, and that this is due to the very general impression that any man can fire. That this impression does largely prevail is very true, but it is a sign of ignorance all the same, and we should like to see the day when the importance of the fireman's position is rated equal to that of the engineer.

Now, as a fact, any man *can* drive an engine so long as the engine is in order. A good modern engine runs the day through without laborious attention. Not so the boiler which supplies the steam, for it is continually varying its *régime*, and it is no mean art which preserves a constant steam pressure in proper conjunction with a proper water level and a quiet safety valve. With such duties it is easy to understand how as much as 20 per cent. of fuel may be shovelled practically up the chimney by an unskilful man. Further, the duties of the stokehole extend to the due cleaning of the boiler, and Mr. Craven refers to plain coal oil as a substance he has used at the rate of a pint per diem per boiler. This he puts by a sight-feed lubricator into the feed. To this we would add that we have ourselves known good results from a composition which smelt strongly of carbolic, and therefore probably contained coal oil, or one of its congeners. Referring to the fact that one-seventh of the engine power of the Buffalo Railway Company is run at high pressure, Mr. Craven defends the taking of the feed water from the hot well of the condensing plant, and passing it through coils in the high pressure exhaust. This, he says, is not liable to introduce very much oil into the boiler, because the proportion of hot well water used is so small. The secondary heaters in the exhaust pipes of the condensing plant are thus avoided. As regards oil, though much of this is mixed with the water of the hot well, a good deal floats away on the surface, and the exercise of discretion in the placing of the pump draught pipe at the bottom of a deep extension of the hot well will reduce oil to a minimum. Whatever be done, however, the feed must be heated, both to save fuel and to save stress in the boiler.

On the advantages of direct driving of dynamos, he claims a saving of 1½ to 3 per cent. of belt slip, and there is also less labour and less wear and tear than in high speed belted dynamos. He advocates capable attention, indication at least once a month for valve adjustment and the keeping of the load as near as possible to the normal, filtration of oil and the use of sponge cloths in place of waste, as the former can be used again and the grease recovered, the saving being no less than 80 per cent. on the cost of the cloths. What has become of the various dry bearings we have heard so much of from time to time? The dynamo offers so wide and suitable a field for their use, that we wonder to see nothing attempted in this direction by the advocates of oilless bearings.

A NEW USE (OR ABUSE) OF PHOTOGRAPHY.

Under the above heading an interesting article has recently appeared in *Photographic Work* which not only illustrates in a striking manner the wide possibilities which exist for the use of photography as a means of continuous registration, but shows, says the article, "that by a no means complex or expensive device there may be obtained a continuous and automatic register of every message and every signal sent through any telegraph wires of a group of about a dozen, provided only that a short parallel line can be laid to the group, even at a distance of 20 feet.

"An experimentalist, who was working in his laboratory with modified forms of telephone, frequently noticed the audible effect of induction from messages and signals transmitted on a group of about eight wires on the adjacent railway, these wires being about 20 feet distant from one side of the circuit (about 60 feet long) in his workshop. The signals were, however, not very distinct, and sometimes several were confused together. It occurred to the experimenter to try if photographic registration of the signals could be effected; some special interest which he took in the details of railway working and management, perhaps serving as an incentive in the matter.

"The wire for the reception of the induced current consisted of two strands of stout copper wire (No. 8, if we are rightly informed) running along the angle of the laboratory adjacent to the railway, the return being by an insulated metallic conductor on the other side of the premises, and of very low resistance; but in the circuit was a coil of rather thick wire encircling a slender, soft iron pole piece on one end of a large but weak compound bar magnet; virtually a telephone without the usual thin iron receiving plate. The soft iron pole piece was about 2 inches long, $\frac{1}{8}$th of an inch square, and composed of six laminæ of very soft and carefully annealed iron, each lamina being extended and wedged into a hole at the end of a bar of the compound magnet. This arrangement was set vertically, the bare face of the pole piece being upwards, and over it was suspended the armature—a piece of ferrotype plate, $\frac{1}{8}$th of an inch square, the suspension being a horizontal strip of steel $\frac{1}{2}$-inch in clear length, $\frac{1}{30}$th of an inch wide, and about $\frac{1}{400}$th of an inch thick. A small opaque screen of aluminium erected on the armature, and having in it a vertical slot $\frac{3}{100}$ths of an inch long and $\frac{1}{200}$th of an inch wide, served as the light-controlling device, a beam of light sent through this slot being partially cut off when the armature moved upwards or downwards. The armature was surrounded with alcohol to render the movements dead-beat. Messages could be recorded in a readable manner by the device, the beam of light being received upon a sensitive plate so revolving that the light should trace a spiral line. The apparatus was mounted in a small cavity dug out in the floor of a cellar.

"The source of light was a minute incandescent lamp outside the alcohol tank, the filament being larger than the vertical slot in the screen on the armature. Inside the alcohol tank was a fixed screen with a slot similar to that in the screen on the armature. The photographic lens looked through both these screens, and also through the alcohol tank at the incandescent filament, the image on the plate when both screens were in register being reduced to one-third linear, or $\frac{1}{100}$th of an inch high and $\frac{1}{600}$th of an inch wide, a cheap French 1-inch microscopic objective serving as lens.

"The sensitive plate was mechanically rotated and moved downwards during exposure, by a device for giving equal lengths of spiral line for equal times, this device being actuated by an electric motor regulated by vanes, and driven by the accumulator working the lamp. The pitch of the spiral inscribed upon the sensitive plate was $\frac{1}{50}$th of an inch, so that if no movement of the armature took place, the exposure line would be $\frac{1}{100}$th of an inch wide, and the interspace also $\frac{1}{100}$th of an inch wide. The plates used were 4 inches square, so commencing the spiral not quite at the centre, and working outwards to about 3½ inches in diameter, each plate would record for 24 hours if a rate of about 1 foot linear per hour was allowed; but this rate, which would only allow the distinction of 120 impulses per minute, was, in many cases, too rapid, it being necessary to run the motor more slowly. To indicate the time on the sensitive plate seemed, at first sight, easy, it being merely required to make the hammer arm of a striking clock cross the path of the beam, the indications recorded on the spiral line being halved; but several difficulties occurred, the action of the clock bringing about magnetic and mechanical disturbances; still, these were ultimately so reduced as not to interfere much with the records.

"Although to the eye the spiral on the plate appeared quite continuous, when microscopically examined, it was found to be a very full record. Any deflection of the armature through its range of $\frac{3}{100}$ths of an inch would narrow the spiral line, and the side at which the narrowing took place would show

the direction of the current. The duration of each impulse was, in most cases, clearly mapped out, and by careful examination, and taking into account the effect of corresponding or opposing currents, several simultaneous messages could be traced and read, and the effect of the various disturbing influences was, on the whole, trifling.

"Having satisfied his curiosity by obtaining occasional records—records which would take several years to fully transcribe—the experimenter sent the portable part of his apparatus to a friend farther north, where we may, perhaps, again hear of it."

Although the success (in a certain sense) of the experiments might cause alarm to many who would imagine that telegraphic secrecy is now rendered a thing of the past, it may be pointed out that a single wire line for important telegraphic work is a thing that does not exist, at least in this country, and it is only from such a line that decipherable records could be obtained, for the jumble of signals which would be recorded from several wires working simultaneously would be, to all intents and purposes, useless for "tapping" purposes; a word here and there might be detected, but that is all. It may be added that a single wire worked "duplex" cannot be tapped.

REVIEWS.

A Standard Dictionary of the English Language. By Isaac K. Funk, D.D., Editor-in-Chief. Vol. I. New York: Funk & Wagnalls Co.: London and Toronto.

The issue of a new dictionary is not an event of very frequent occurrence, and it is still more seldom that such an issue as the splendid example before us takes place. Over a thousand 4to pages for the first Vol., up to letter L, is certainly a remarkable achievement, especially as the type, though beautifully clear, is small. Not only are there very numerous small illustrations, but several finely executed page plates, several of which are beautifully coloured in the highest artistic style, make the volume quite a gem. Indeed, taking the book as a whole, it is difficult to imagine how anything of the kind could be carried to a greater perfection than has been the case in the present instance. It is stated on the title page that over 200 specialists and scholars have been engaged in the work of preparation, under the supervision of an editor-in-chief, a consulting editor, a managing editor, and three associate editors. Although the work has been chiefly compiled by American authorities, we notice the names of Professor Max Muller, Mr. H. M. Stanley, Professor Huxley, Miss Amelia B. Edwards, Professor E. Ray Lankester, and others, as foreign contributors. Such names as the Hon. E. J. Phelps, the Hon. Emerson E. White, which strike us on looking down the list of eminent authorities, are sufficient to indicate that no pains have been spared to give an unexceptional authoritative tone to the whole compilation. Coming to the portion of the work that immediately concerns our own profession, we observe that to Mr. R. W. Pope has been assigned the task of putting together the list of electrical terms. Casually we turn to the subject "battery," and we find half a column of excellent matter describing briefly various kinds of cells (Minotto, as usual, is spelt wrong, being given as Menotto). From "electric" to "electrovectia" we have nearly six columns, with an immense mass of matter skilfully crammed in and condensed; an illustration of an "electrocution chair," it may be remarked, is given. The term "electrification," we notice, is not stated to apply to the phenomena of increase of resistance observed in testing dielectrics for insulation. Such words as "conductance," "hysteresis," "inductance," "lag" (magnetic), are all to be found appropriately explained, in fact, as far as our examination went we were unable to detect any omission of electrical terms that occurred to us, and that we looked for. The arrangement of the pages on the "where is it" principle, is an excellent feature of the volume, and adds most materially to its value, of which we cannot speak too highly.

The Scottish Educational Year Book and Diary for 1893. Aberdeen: The *Free Press* office.

This book is a handy compendium of facts relating to the work of public education in Scotland. A digest of H.M. inspector's reports is included.

CORRESPONDENCE.

Electric Lighting of Folkestone.

You appear so determined to distort the facts in connection with my appointment as consulting engineer to the Folkestone Corporation, that I have been forced to the conclusion that, so far as you are concerned, I cannot hope for anything but misrepresentation or quibble.

Surely you cannot suppose that your readers are so easily influenced by you as to believe, as you would have them believe, that because on September 26th there was a motion on the agenda paper to reconsider the rescinded scheme of the first committee, that therefore the first committee was then in existence. Then again, why do you refrain from taking your readers a little further into your confidence, and telling them that, although this motion was on the agenda paper, it was nevertheless not discussed, nor even referred to? Yet again, why have you not, in your burning desire for the welfare of the electrical industry, informed your readers that Mr. Baker, and some of his friends, based much of their opposition to the £35,000 scheme on the fact that the Corporation's first engineer had recently carried on business as a photographer at Sandgate, and that his name was not to be found as a member, or even, I believe, an associate in the lists of any one of the three engineering "Institutions?"

Putting aside for the moment all other considerations, I maintain that it was impossible for me to treat "unprofessionally," or without "keen regard for etiquette," a gentleman whom I could scarcely recognise as belonging to my profession at all.

Francis Hastings Medhurst.

October 31st, 1894.

Mr. Francis Medhurst, in his letter to you, and appearing in your issue of the 26th inst., states:—"You charge me with having allowed my name to be brought before the Corporation (of Folkestone) as the author of a rival scheme, when actually that Corporation was employing another engineer. I wish to point out that your statement is absolutely false, and unwarranted by the facts."

Permit me to inform you that your statement was perfectly correct, though put very mildly, and that it is Mr. Medhurst's own statement which, to use his own language, is "absolutely false;" the undeniable proof of which I now give you, and which is entirely independent of my *ipse dixit*.

On January 10th, 1894, the report of the Electric Lighting Committee was presented, and by motion duly passed and received; this resolution has never been revoked. The discussion of the report was adjourned, and on April 6th a special meeting of the Corporation was convened to consider this report, and, in the course of the discussion thereon, the following statements were made. I quote them from our official *verbatim* report, taken by directions of our Town Clerk:—

Mr. Baker: (loq.) . . . . Now, sir, I have obtained an estimate of the cost of such a scheme (*i.e.*, the rival scheme), from a gentleman who is an authority in these matters, and he calculates that the cost, including the site and everything, would be about £12,000.

The Mayor: Can you oblige us with the gentleman's name?

Mr. Baker: I don't think it is worth while going into the details; the gentleman is Mr. *Francis Medhurst*, consulting engineer to *five* or *six London vestries*. (Some items read, including £750 for site.)

The result of the discussion was actually the adoption of the report and its recommendations, one of which latter was that Mr. Parker's services should be engaged. Notwithstanding the adoption, &c., of this report, Mr. Medhurst still continued to aid Mr. Baker in his attempts to overthrow it, and which culminated in an organised meeting at the Town Hall on April 23rd, when undoubtedly an adverse verdict was returned, but no one was granted a hearing in favour of the scheme. I myself was warned in the morning that I was to be shouted down, and so it turned out. There were present at the meeting between 400 and 500 people (how many were ratepayers I cannot say) out of 3,700 ratepayers on the burgess lists.

Mr. Baker and others have uttered so many slanders of Mr. Parker, that perhaps in justice to him you will permit me to add that there is no resolution on our Corporation records "dismissing him." True it is that his scheme and

our report is (owing mainly to Mr. Baker's hostility), in a state of suspension. Mr. Parker appeared before our committee with high testimonials, these were supplemented by numerous private enquiries which were made by individual members of our committee, with the result that he was *unanimously* recommended to the Corporation for engagement to carry out the works.

Mr. Medhurst is presented to the Corporation, I presume, with his knowledge, for it cannot have been invented, as an *eminent* consulting engineer *well known* in the electrical world, as the consulting engineer to *five* or *six* London vestries, as the consulting engineer employed in the installations erected at Barcelona, St. Petersburg, Lyons, Cambridge, Devonport, Wigan, &c. All this may be true, although it does not coincide with some information forwarded to me; but Mr. Baker declined in council to specify the London vestries, or to inform us what was really done in the places named, and no testimonials are produced from any of the authorities having charge of the installations named.

Geo. Evan Thompson.

Peroxide Lead.

In your issue of September 14th, you publish a paragraph with title, "A Cheap Insoluble Anode." Can you tell us how Mr. FitzGerald prepares peroxide of lead for use as anodes in the electrolysis of alkaline chlorides?

The Pennsylvania Salt Manufacturing Company,
Theo. Armstrong, *President.*

[So far as we are aware, there are no means known for treating peroxide of lead so as to form anodes for use in electrolysis. For this purpose the *protoxide* of lead (*litharge*, if the oxide has been fused, or *massicot*, in the contrary case), has first to be obtained, by various patented processes, in the form of plates or slabs which will not disintegrate when immersed in water or dilute sulphuric acid, and the protoxide in this form has then to be converted into the peroxide by being made the anode in the electrolysis of the latter electrolyte. The material thus converted has been termed lithanode by Mr. Desmond FitzGerald, who has, we believe, taken out several patents in the United States, as well as in most European countries. The plates, which are intended to be built up into anodes of large surface, are of special quality; high conductivity, which is not necessarily associated with great capacity for charge, nor with a high rate of charge or discharge, being in this case the most important requisite. In building up the anode a frame of wood or vulcanite is used, to which 12, 16, 20, or more lithanode plates are attached by means of vulcanite screws and nuts. The size of the plates is usually 7 inches × 4 inches × $\frac{3}{16}$-inch, or 4½ inches × 3 inches × ⅛-inch. Thick wires of copper or lead, having inch lengths of platinum wire soldered to them at intervals of about 3 or 5 inches, are embedded vertically in the frame; being carefully insulated within grooves provided in the latter, with the exception of the platinum wires, which are left projecting at right angles to the embedded conductor. These wires establish contact with the lithanode plates by means of washers of very thin platinum foil, which are in contact with the lithanode; the platinum wire being brought into contact with the platinum foil, a washer of elastic material being superposed, and the contact being securely maintained by the aforesaid vulcanite screws (which pass through frame, lithanode, and washers) and their accompanying nuts. It is claimed for these anodes that they can be made nearly as cheaply as those of carbon, whilst they are not liable to disintegration nor to chemical action by chlorine.—Eds. Elec. Rev.]

Tenders.

You will have seen by the reports in daily papers that the tenders for the wiring, &c., of the new police buildings at Aberdeen were opened on the 10th inst., when they were found to consist of Messrs. Shirras, Laing & Co. (accepted), £143 18s., Messrs. New & Mayne, £186, and the Faraday Electrical Engineering Company, Limited, £265. The work to be done consisted of 192 lighting points; in the aggregate the lights were equal to 264 lights each 16 C.P.

In addition to this, one main switchboard made up of 3 enamelled slates, fitted with switches, cut-outs, and bus bars for 5 distributing switchboards, all on the three-wire system, were required, and 64 boards for switches and cut-outs in the various rooms. The whole of the wiring had to be at least equal to 600 meg. lead, and a considerable portion had to be laid underground in iron pipes; the area of the lighting extended for upwards of 200 feet from the main switchboard. I should be glad if any of your readers can show how it is possible to undertake the work at the above price; in my opinion it leaves about 4s. per lighting point for the wiring.

Ohm.

October 30th, 1894.

Turning Down Electric Lamps.

After making a little mis-statement and then having the bottom knocked out of it, and then making another and having the bottom knocked out of it also, you feel that you must say something more, so you say that my switching arrangement is "without the slightest novelty." Well, I will tackle you here on one point only: Take my system of switching from one series to another—the one you have been discussing in such an amiable manner—if it is without the slightest novelty, you can easily give me the date of the patent which is antecedent to mine, or, if it is in use without having been patented—where? and since when?

Thomas Budworth Sharp.

October 30th, 1894.

[We will readily oblige Mr. Sharp at the risk of once more having the bottom knocked out of what we say. Going no further back than patent No. 19,874, A.D., 1892, we assert emphatically that, in our opinion, this specification knocks the bottom out of Thomas Budworth Sharp's patent, No. 17,025, A.D., 1893.—Eds. Elec. Rev.]

Localising High Resistance Faults in Submarine Cables.

Perhaps you will allow me to briefly answer Mr. J. Rymer-Jones's letter in last week's Electrical Review, in which he notices my comments upon his article in your columns *re* "Localising Faults between Ship and Shore by Clark's Fall of Potential Test." Throughout this article, Mr. Jones speaks of using slide resistances of 100,000ω; but *now* he assumes conditions in the old "null" method of measuring p^1, such as would arise were a resistance *of only 10,000*ω available—an extremely rare contingency in practice, every properly equipped cable-steamer being provided with "slides," as also a *sufficiency* of Clark's standard cells. Moreover, Mr. Jones appears to think that the momentary application of ship's "slides" and balancing battery through a tapping key must so alter the potential at high resistance faults, as to vitiate the results. Such is not my own experience. Again, his letter conveys the idea that p^1 is a fixed and unalterable quantity, whereas it can always be varied at will, if necessary, by merely instructing "shore" to increase or diminish his pre-arranged battery power. Again, Mr. Jones justly expresses solicitude for his standard cells, but with simple precautions. What greater objection is there to balancing these against p^1 direct, than exists in the like method, as adopted by himself, of determining the E.M.F. of his testing battery by slides in terms of the self-same cell or cells? (See his fig. 3). To sea-going electricians generally I would leave the verdict, as to whether his *modus operandi* of measuring the fault potential from a cable repairing steamer is or is not tedious and unpractical at a moment when, as a rule, the time for making observations is of necessity so limited. He himself now admits that for high resistance and varying faults (the very class in connection with which he condemns the old procedure) *prolonged readings would be desirable*, and undoubtedly the time thus occupied would in many instances imperil the cable, if not involve its loss.

In conclusion, of course the ordinary marine galvanometer, however perfectly balanced may be its mirror system, is un-

suitable for comparing throws, but I think that Mr. Jones over-estimates the slight discrepancies occasioned by rolling, inasmuch as these can be practically eliminated by suitably timing one's observations. The new pattern galvanometer mentioned in my last letter, has, however, great dead-beatness, and is, moreover, fitted with a device for preventing sag of the suspension—the cause of the discrepancies to which he alludes.

F. Alex. Taylor.

The Magnetic Properties of Asbestos.

My attention has been drawn to a letter, signed E. Hancock, in your issue of 26th inst., which questions the accuracy of the facts relating to the magnetic properties of asbestos, contained in my communication published in your issue of October 5th.

Mr. Hancock does not appear to have understood—or even to have carefully read—my remarks, or he would see that the results obtained could not possibly be explained in the manner that he suggests. As I mentioned, permanent magnetic polarity was distinctly produced in the asbestos. Further, other substances, such as mica, glass, wood, and pasteboard, were not attracted at all. The attraction, therefore, must have been of a magnetic, and not of an electrostatic nature.

Mr. Hancock must, indeed, be a man of phenomenal energy if he can rub his stick of ebonite sufficiently hard to make it exert an electrostatic attractive force of 4½ ounces. His powers in this direction would seem to be more remarkable, even, than his knowledge of the subject of which he ventures to treat.

A. A. C. Swinton.

October 27th, 1894.

Design of Large Alternators.

I would be greatly indebted to your paper if it could spare space for a few words on alternating current machines.

An article in a recent issue of the Review, by Mr. Rankin Kennedy, opens with a complaint of the lack of criticism on the design of large alternators. The ground taken by the writer, and the views advanced, furnish an excellent opportunity for opening the discussion.

Coming into prominence as it did after the continuous current machine had attained a commercial success, the alternator has had applied to it all the experience so gained, as well as the ability of mathematicians, who had been attracted to this branch of physics, so that at the present day the alternator, instead of being an enigma, is a machine that is better understood, and can be designed with a greater degree of accuracy, than the continuous current machine. Special conditions will demand special design, but a good alternator will possess the following features :—

1. It should be efficient as to conversion of energy.
2. It should be efficient as to life—that is, the repairs must be a minimum.
3. It should be so designed that it can be entrusted to the care of unskilled attendants without injurious results.
4. It should be sold at a moderate price.

Other considerations are more or less governed by special cases, and will not enter into the design of the general machine.

The advantage of one type alternator over another in regard to efficiency of conversion can be set aside, as one may be as efficient as another with proper designing.

With regard to life efficiency, however, there is a great divergence. A machine should be so constructed that it will stand all the excessive strains and possible short circuits involved in commercial work, especially in parallel running, now so generally practised.

Machines may be divided into two broad classes, those of low and those of high armature inductance. For instance, take the case of a machine having little or no inductance in the armature, as in a machine with disc armature revolving between poles. Such a machine will have a very strong synchronising power when running in multiple, but if from any cause the field circuit of one machine becomes broken, the sudden rush of current through its armature from the others will be enormous, and will either burn it out or wrench the conductors from their frail support and practically destroy the armature, as has been proved in practice.

Also, with a machine of very low armature inductance, the regulation of the field current will require very close attention to prevent a large cross current, and also a possible dropping out of phase.

Throwing into synchronism will also require great care that the machine is exactly in step with the others.

With an armature having a sensible amount of self-induction, the rush of current on falling out of step will be limited to perhaps double the normal, which will not be dangerous for a short period, also breaking the field of a machine of this class need not throw it out of step. The fields of two ironclad machines running in multiple can be varied within wide limits, without interfering with their keeping in step.

Again, in commercial work, there is more or less liability of a short circuit on the lines, which will have the same injurious effect as falling out of step upon the machine having a low armature inductance. It is evident then that the machine that will give the best satisfaction in practice is the one having a fair amount of armature inductance.

Again, considering the mechanical design, it will be evident to any engineer that that design will be the best which gives a good driving support to the armature wire, and which will also enclose that wire, and prevent mechanical injury to it. This can only be done by adopting some form of ironclad construction, which not only allows the armature to be handled with comparative safety, but gives far better mechanical support to the coils than any other form.

As a further argument in favour of ironclad construction, and one that will be truly appreciated by commercial men, I would point out that there are on the market to-day but one or two types of machines using armature without iron, where there were a number a few years ago, and that all makers now almost invariably adopt the ironclad construction, except in special cases.

Passing over now the commercial aspect, and coming to the comparative merits of these two classes of machines, I find many exceptions to Mr. Kennedy's statements.

Taking the case of cast-iron against laminations, cast-iron can never be worked to advantage higher than 35,000 C.G.S. lines per square inch. Laminations can readily be worked at double this intensity, and require only one-fifth the ampère turns to force this flux through the iron. This means then a saving of one-half the weight of iron, and an expenditure of one-fifth the energy required for magnetising the iron circuit for same total flux by using laminations. The cost of laminations is about 1·4 times the cost of cast-iron, and the cost of working will reduce the advantage still more, so that the gain in using them is about 25 per cent. over cast-iron in cost of material, and a considerable saving in energy while against cast-steel the saving will be still more.

Taking up now the question of leakage, a well-designed iron-clad machine will have about 15 per cent. leakage. In the case of a flat ring armature between two rows of poles of like polarity on one side, or like the Mordey type for which a minimum leakage is claimed, the leakage will be much more, for the following reasons :—The flux in this machine will have to provide for a complete variation in E.M.F. from maximum to minimum, while in the Lontin type a coil cutting the flux will vary from a maximum to zero, and when passing beneath the next pole of opposite polarity, will vary from zero to a minimum. That is, while in the flat ring type the flux must provide for a complete cyclic change, in the Lontin machine one pole provides for only half a cycle—therefore any leakage in the flat ring machine will have double the effect on the useful flux that it will in the Lontin type. The poles are much nearer together in the flat ring type, making actual leakage of lines larger, so that the claims advanced for a lower leakage are not based upon sound reasoning, but, in fact, it will be much greater.

By using a laminated structure, eddy currents are practically avoided; variations in flux cause no concern on this score. But in the flat ring type using cast-iron poles with a coil between them, this is the reverse. The flux, instead of being steady as claimed, will fluctuate every time a coil carrying current passes a pole face. This fluctuation in flux in a cast-iron pole will produce enormous eddy currents, which will only show under load.

Again, the construction of this type of armature demands as great rigidity as possible, so that armature coils should be

preferably solid and not stranded. If this is the case, there will be heavy eddys generated in them, as the field in the armature is by no means uniform.

To sum up the disadvantages of the flat ring type machine:—

The mechanical design of the armature is very frail for the great strain put upon a commercial machine. It may be good construction for the laboratory where it is in the hands of a skilled attendant, but it is too fragile for commercial work.

The eddy currents in both armature coils and cast-iron poles are excessive and not well avoidable.

The low self-induction of armature prohibits its use for commercial work, where multiple running is practised, on account of its liability to destruction on short circuit, and also on account of the great care necessary in their operation.

A case illustrating this lately occurred in the London station, where a flat ring type machine was running in multiple with an ironclad. A short circuit occurring on the mains, the flat ring armature fell out of step and was destroyed, while the ironclad was uninjured.

These constitute a few reasons why the ironclad laminated construction is the best.

A. H. Armstrong.

General Electric Company,
Schenectady, *October 15th*, 1894.

BUSINESS NOTICES, &c.

Universal Electrical Directory (J. A. Berly's).—Messrs. H. Alabaster, Gatehouse & Co. have now in course of preparation the 1895 edition of this directory, which embraces all connected with the electrical trades throughout the Universe. It is indispensable to all having business transactions in the electrical world. Names and addresses for insertion, corrections, and orders for advertisements should be promptly forwarded.

Aberdeen.—The Gas and Electric Lighting Committee of the council last week considered a supplementary report from Prof. Kennedy on the proposal to extend the electric mains to the top of Holburn Street. Prof. Kennedy stated in his report that he anticipated an outlay of £950 in addition to the sum already estimated, bringing the total estimate to nearly £5,000. Consideration of the report was adjourned.

The installation of the electric light at the Joint Station has now been completed, the light being turned on for the first time on 23rd ult. There are altogether 22 lights, disposed as follows: 11 within the station arch, 4 on the south platform outside the station, 3 on the platform north of the station, and 4 in the area in front of the station buildings. The lamps are of the Crompton-Pochin type, and vary in power from two to three thousand candle-power. The dynamos from which the current is supplied are those of the Palace Hotel, and an additional dynamo has been added to those already in the Hotel, so as to cope with the increased supply necessary. This has brought up the total power of the plant to 150 units, or a power equal to 2,300 incandescent lamps of 16 candle-power each. The installation has been carried out by the Faraday Electrical Engineering Company, Mr. Horne being the active superintendent of the work at the station. The covered entrance to the Palace Hotel is to be fitted up with Sunbeam lamps.

Belfast.—The new premises of Messrs. Steel & Sons, electroplaters, &c., in Royal Avenue, are lighted by electricity, the plant being laid down by Mr. W. H. Drennan, of Fountain Street.

There were 93 applications for the post of assistant electrical engineer. This list was reduced to 10, and Mr. Frank Wilson appointed by the Council.

Bolton.—Wesley's Chapel, Bradshawgate, is to be lighted on Sunday by electricity for the first time. A local company carried out the work at a cost of £150. There are 32 C.P. lamps in the chapel, including a central corona. There are altogether 62 lights from the roof, 12 under the gallery, and 2 lights of 50-C.P. in the transepts. The mission room beneath the chapel is to be lighted by 67 8-C.P. lamps.

Bootle.—The Town Council last week passed a resolution deciding to apply for a provisional order for supplying the borough with electricity.

Bradford.—Upon the occasion of a bazaar recently held at the Allerton Congregational Church, the premises were lighted electrically by Messrs. Andrews & Preece.

Bristol.—The Electric Lighting Committee have received an application to supply current in that portion of St. Stephen Street where no mains are laid. A canvass is to be made by circular to ascertain the probable consumption in the event of mains being laid there.

Cambridge.—Mr. W. M. Fawcett, the architect who drew up plans and specifications for the electric lighting station which the corporation at one time intended erecting and running themselves, but which a company subsequently did, has agreed to accept £250 in discharge of all claims against the corporation.

Cardiff.—The Corporation want a foreman to superintend the machinery at the electric light station. They advertised for a Cardiff man, but none of the replies came from persons sufficiently qualified for the post, and now they have resolved to advertise generally for a suitable man.

The Aberdare Hall authorities are desirous of lighting the institution by electricity, and the corporation estimated a minimum charge of £30 per annum, plus the cost of the actual consumption of current. The institution cannot afford such a sum, and a deputation last week conferred with the Lighting Committee. Mr. W. H. Massey said in order to supply the Aberdare Hall with the electric light they would have to lay down 1,200 yards of high tension mains; and the borough engineer added that they had not had a single application from Park Place or the neighbourhood. It was agreed to instruct the town clerk to inquire into the subject.

Chelmsford.—Upon the occasion of an art exhibition last week, the Chelmsford Electric Lighting Company gave displays of various methods of cooking.

Cheltenham.—Salem Chapel is being fitted with electric light. The installation at first will comprise the chapel, vestry, lecture room, committee rooms and reception rooms, and be equivalent to about 270 incandescent lamps of 8 candle-power. The contract has been placed in the hands of Mr. A. G. Sanders, A.M.I.E.E.

Clifton.—In connection with the extension of the electric light to Clifton, it is stated that the Clifton College authorities will take for the college and the masters' houses near it as many as 1,000 incandescent lamps.

Coventry.—The householders are to be circularised as to the probable consumption.

Croydon.—The Croydon County Council, on Monday night, decided that the Corporation should arrange with some company to establish an electric lighting installation for a compulsory area at such contract price as the consulting engineer of the Corporation may approve, and "that the Corporation should find the necessary capital for the above purpose." A sub-committee has been authorised to obtain the advice of a consulting engineer, to make all needful enquiries, and to report further.

Dewsbury.—The Corporation are inviting applications until to-morrow at 12 noon, for the following appointments at the electric lighting station: Engine driver, stoker, dynamo attendant, jointer, office clerk, and meter inspector.

Dundee.—In connection with the decision of the Gas Commission to erect two electric lamps in front of the new offices in Commercial Street, it has been agreed to procure the pillars from Messrs. Walter M'Farlane & Co., Glasgow, at £8 per pillar.

Durban.—Complaints have been made regarding nuisances arising from the smoke from the electrical lighting station, and the Town Council resolved on September 6th that the contractors, Messrs. Woodhouse & Rawson, be called upon to abate the nuisance within 14 days by the heightening of the chimneys or otherwise.

Edinburgh.—It is expected that the electric lighting works will be in such a position that current can be turned on some time during March, 1895.

The new buildings of the Royal Edinburgh Asylum for the Insane are lighted with 200 incandescent lamps.

Fareham.—The electric lighting wires have to be placed underground, and to facilitate the work the Local Board have decided to recommend the company to make certain alterations in the positions of lamps, and also to erect certain additional lamps, the total cost to the company being about £53. They recommend the carrying out of these improvements before the undertaking comes into the hands of the Board.

Featherstone.—The Acton Hall Colliery Company are to be requested by the Local Board to light the centre of the archway in Station Lane by gas or electricity.

Germany.—The Continentale Gesellschaft für Electrische Unternehmungen is the name of a new concern which has just been organised at Nuremberg with a capital of £800,000. The company will work in conjunction with Messrs. Shückert & Company, of Nuremberg, who are financially interested in the new undertaking.

Hammersmith.—The vestry are circularising the ratepayers for the purpose of ascertaining the probable demand for current. They propose to charge 8d. per Board of Trade unit, estimating that an 8 C.P. lamp will at this price cost ½d. per hour, while the cost of wiring and fitting will run from 20s. per lamp upwards according to the quality of the fittings. For motive power, heating, and cooking, specially reduced rates will be charged.

Hanley.—The minutes of the Electric Lighting Committee passed by the Town Council last week contained the following: "An application had been received from Messrs. McIlroy Bros. for electrical energy to supply 219 electric lamps at their premises in Miles Bank and Lamb Street, but the engineer reported that if the

markets were lighted all the available energy would be taken up. The committee recommended that the application in question, also another for a supply of 16 lamps, be complied with. It was further resolved: 'That this sub-committee having found the existing plant and machinery insufficient to supply the demands for energy for electric lighting, tenders for an additional engine and alternator be obtained, and that the electrical engineer be requested to submit at an early meeting a scheme for the extension of the plant and mains for supplying the electrical energy likely to be required within the area of supply, that part of the scheme relating to the compulsory area being submitted for first consideration.' The sub-committee also recommended that the Town Clerk be requested to write to the Brush Electrical Engineering Company requiring them to forthwith put the electric lighting plant and machinery in proper working order to the satisfaction of the Borough Surveyor, in accordance with the terms of their contract."

Hereford. — The premises of Messrs. Hatton Brothers, boot manufacturers, have been lighted by electricity, the plant consisting of a 16 H.P. gas engine and an Elwell and Parker's dynamo. There are 88 16-C.P., six 50-C.P., and eight 32-C.P. incandescents, and one 8-ampère Byng arc lamp. The work has been executed by George Reakes & Co., of Shrewsbury, who have also carried out extensive telephonic communication for Messrs. Holloway & Co., upholsterers, of the same town. They have also carried out extensive telephonic communication on the Bridgewater estate.

Hull.—At a meeting of the Electric Lighting Committee, last week, the chairman stated that for the quarter ending September 30th they had delivered to consumers 20,149 units against 10,740 units in the corresponding quarter last year. Their expenditure was £1,927 8s. 8d., and their income £2,013 16s. 6d., so that they had a balance of £86 7s. 10d. in hand, and the best quarter to come. They hoped by the end of the year to present a very flattering report.

India.—It has been decided to light the new Post Office at Ceylon with the electric light, and Messrs. Boustead Brothers have been given the contract, and will carry out the work through Mr. J. Torr Todman, their electrical engineer. In the illumination of the building 28 arc lamps will be used, and about 100 incandescent lamps. Twelve arc lamps will be used outside the building. Around the pavement in front of the Post Office there will be eight fancy lamp-posts bearing lights; while four others will be placed at the corners of the building outside. Then there will be four arc lamps in the main hall, and eight in the sorting department. There are two sets of residential apartments within the building, and these will also be lit by incandescent lamps, while all the other parts of the building will be illuminated in the same way.

There is a proposition to light the new Government House, Rangoon, the Gymkhana Club, the lunatic asylum, and the Central Jail with the electric light, the dynamo and machinery being worked in the jail.

Islington.—The work connected with the laying of mains in the Islington and St. Luke's districts was commenced last week.

Kensington.—The Vestry has decided to sanction the application of the Notting Hill Electric Lighting Company for a provisional order for supplying the northern part of the parish recently abandoned by the House-to-House Electricity Company.

Kingston. — The Lighting and Market Committee's minutes passed the other day contained the following items:—Resolved that the borough electrical engineer be authorised to draw up a circular letter to all persons on the circuits where the electric cable is being laid, calling their attention to the benefit to be derived by using the electric light. The borough electrical engineer was instructed to report at the next meeting the probable cost of laying mains for charging electric launches. The engineer also reported that a letter had been received from Mr. W. H. Preece, engineer-in-chief to the General Post Office, inquiring on what terms the Corporation would supply current to the Post Office at Kingston. The further consideration of the matter was adjourned to the next meeting. The Chairman reported that the floor at the electric light station was in an imperfect condition. Resolved that the borough surveyor be instructed to report at the next meeting as to the cost of laying down block flooring. The consulting engineer reported that a new boiler was necessary at the electric works. Resolved that the same be ordered from Messrs. Bellis & Co., similar to the previous boiler, but with certain modifications. The consulting engineer handed in a certificate for £2,000 to Messrs. Siemens, viz., £1,000 on account of work under their contract, and £1,000 for general work. Resolved that such certificate be passed on to the finance committee with a recommedation for payment by the council. A letter was read from Messrs. Siemens with regard to the arc lamps, in which they said: "With the view of showing our confidence in the cables already laid, we are prepared to extend the guarantee we have given under our contract for twelve months, and until the expiration of this period we will make good, free of expense to the Corporation, faults which may show themselves in these cables, and which are clearly traceable to defects in the cables themselves." Resolved that the council be recommended to make application to the Local Government Board for permission to borrow a further sum of £4,000, and that the necessary steps be taken so that the enquiry may extend to the above mentioned sum as well as to the £6,000 already applied for. Resolved that the town clerk write to the Gas Company, asking on what terms they will be prepared to light the public street lamps for the ensuing year. These minutes have been adopted. It is desired to have one public enquiry for borrowing the two sums.

Killarney.—At the last meeting of the Board of Governors of the District Asylum, Sir Maurice O'Connell moved that an amendment passed on October 18th, as moved by Mr. Moriarty, and which was carried by a majority of one, affirming the acceptance of the tender of the Killarney Electric Lighting Committee for the lighting of the Asylum, and applying for a loan for that purpose, be rescinded. There was a good deal of amusement when it was found that eight voted for and eight against this resolution. Accordingly, no decision has yet been arrived at.

Llangollen.—The London firm to which we referred a few weeks ago as desiring to carry out certain experiments regarding the electric lighting of Llangollen, was Messrs. Easton, Anderson and Goolden, who conducted these experiments on Friday and Saturday, the 19th and 20th ults. On the first night they lighted the grounds of a Bowling Club by three 2,000-C.P. arc lamps. The following day the apparatus was removed to the town and lighted up the fronts of several of the more important establishments in Castle Street.

Limehouse.—It is stated that the Electric Lighting Committee has become defunct, consequently the electric lighting question has been receiving no special attention lately.

Liverpool.—The proposal of Alderman Smith, to which we referred last week, appears to have been favourably received by the Council. The resolution passed last Friday was as follows:—"That the present position of the Liverpool Electric Supply Company with the Corporation be referred to the Watch Committee and the Health Committee for their observation and report."

London.—The City of London Electric Lighting Company were summoned to Southwark Police Court, last week, for causing a nuisance to arise by the emission of smoke from their shafts. A representative of the London County Council having stated that alterations had been made to obviate the violation of the law, the summons was withdrawn.

Messrs. Willans & Robinson have recently received an order from the British Thomson-Houston Company for several large engines for the Bankside Station of the City of London Lighting Company which we imagine is one of the most important orders for electric light engines ever received in this country at one time. There are eight engines in all, of 700 I.H.P. each, to run at 300 revolutions per minute, coupled direct to Thomson-Houston alternators, and, we believe, they form part of a complete order which the Thomson-Houston Company have received for engines, dynamos, boilers, pipes, exciter plant, &c. The Thomson-Houston Company have already at this station put down four Willans engines of 300 I.H.P. each, coupled direct to their alternators, and it is, doubtless, the very successful working of these sets, both mechanically and electrically, which has led to the present order.

The Commissioners of Sewers last week referred the proposal to include Finsbury Circus among the main streets for electric lighting purposes to the Streets Committee.

St. Peter's Church, Eaton Square is now provided with electric lighting.

Luton.—The committee appointed to consider the electric lighting question have now presented their report, and, as a result of their recommendations, a provisional order is to be applied for by the Council.

Newcastle.—The Town Council have decided to apply for a provisional order to give them authority to negotiate with the Tramway Company in regard to the proposed cable system. An amendment, asking the Council not to have anything to do with the matter at present, was lost by a majority of three votes.

Newhaven.—Last week a system of electric lighting was inaugurated along the wharves and in the sheds and offices of the L. B. and S. C. Railway Company, Newhaven. The light, which has been installed by Mr. J. W. Jackson, an electrician of the company, is derived from two dynamos.

New Swindon.—Upon the recommendation of the Electric Lighting Committee, Mr. J. G. W. Aldridge, of Westminster, has been appointed electrical engineer to confer with the Local Board regarding the electric lighting provisional order. The application for provisional order is to include every street and public building in the Board's district.

Norwich.—The electric light installation has now been completed at the Norfolk and Norwich Library by Messrs. Laurence, Scott & Co. The total cost, including fittings, was £110. The report of the Committee for the past year states that they consider the improvement most satisfactory.

Ormskirk.—Messrs. W. & J. Robinson & Co. have purchased a piece of land in Southport Road upon which they propose to erect electric lighting works, and manufacture all appliances in connection with the electric lighting.

Paddington.—The guardians have decided to light the male wards and the administrative department of the Infirmary by electricity, and an estimate of the cost of such lighting is to be prepared.

Penrith.—The chairman of the local authority moved the other day that a provisional order for electric lighting be applied for. There being no seconder the matter fell through.

Redcar.—The Local Boards of Redcar and Coatham are to be approached by a proposed electric lighting company with a request for sanction to the laying down of electric lighting cables in the public streets. From calculations prepared it is believed that the cost of electric lighting will be lower than that of gas.

Rhondda.—At a recent meeting of the Local Board, a discussion took place upon the proposal by one of the members that

the various streets and roads in the valleys now lighted by gas should be illuminated by electric light. Mr. T. Griffiths, M.E., head manager of the Cymmer Collieries, Porth, stated that he was quite prepared to lay an installation at his collieries to generate sufficient electricity to light the whole of Porth and the Cymmer district, as well as the collieries belonging to the company, at a cost not greater than that charged by the gas company. It was agreed that the clerk should write to the other colliery companies asking them if they were prepared to supply the other portions of the valleys. The Cwmparc district, where the Parc and Dare Collieries (Ocean) are situate, is already lighted by electricity generated by a powerful dynamo at the Parc Colliery.

Salisbury.—The Town Council have decided to offer no objection to the form of licence of the Salisbury Electric Light Company as approved by the Board of Trade.

Southampton.—The question of lighting the municipal offices, including the Council Chamber, by electricity, is being considered by a committee.

Sunderland.—The Museum and Library Committee have again considered the question of the electric light. An estimate was submitted placing the necessary installation at £314 and the annual cost of the light for the whole building at £165. The committee recommended that at first the light be applied only to the library and reading room, and the matter stands adjourned till the next meeting for estimates to be obtained for that purpose.

Switzerland.—A proposal is at present receiving consideration in Switzerland for the establishment of a State Electrical Standardising and Testing Station.

Walthamstow.—The Local Board have now decided to apply for a provisional order for lighting the district by electricity. Only the central and most populous part of the parish is included in the present application.

Woolwich.—St. Mary Magdalene is lighted by electricity. Altogether there are 80 lamps. The gas fittings remain in case of an emergency.

Worcester.—On Friday evening last a supper was given to the electricians and others who had exhibited at the electrical exhibition.

Wycombe.—A Mutual Improvement Society, last week, passed a resolution to the effect that the Corporation is not justified in incurring expense upon the electric light.

A New Lubricator.—A new lubricator, known as the "Multiple," is being introduced into the market by Messrs. Wm. Reid & Co., of 112, Fenchurch Street, E.C. Fig. 1 gives a general

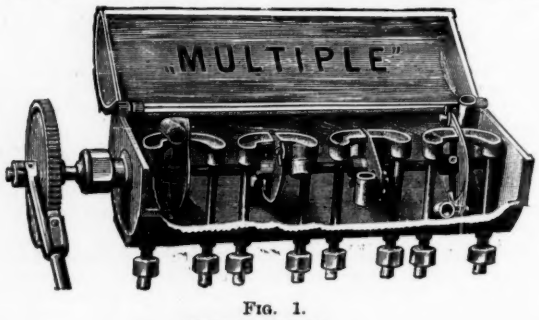


Fig. 1.

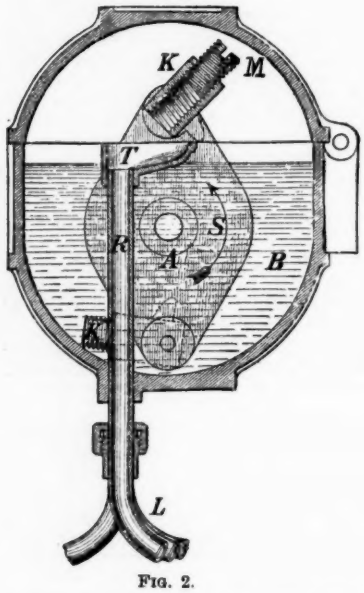


Fig. 2.

view of the apparatus which is asserted to effect a very high percentage of economy in the oil used for lubricating bearings, the saving being stated at from 50 to 75 per cent. The makers claim a number of important advantages for the lubricator, in addition to its economy. Fig. 2 shows the apparatus sectionally. B is the oil box, through the bottom of which are placed a number of tubes, R. These tubes are provided with funnels, T, and connected outside with tubes to the different bearings. The oil is lifted to the funnel, T, by small cups, K, which are placed on the revolving plates, S. These plates are fastened to the axle, A, which passes through the oil box, and is connected to a ratchet wheel and lever to any moving part of the engine. In the course of revolving the cups empty the oil into the various oil pipes, and the quantity each cup supplies can be regulated by the screw, M, which forms the bottom of the cup. Each bearing can therefore be provided with the necessary quantity of oil required. Messrs. Reid have sent us a neatly prepared illustrated price list of these lubricators, which are made in sizes from 4 inches to 20 inches.

Agencies.—Mr. Edward Maybury, of Lancelots Buildings, Chapel Street, Liverpool, has been appointed agent there for Le Carbone, 7, Cartaret Street, London, and at Paris, for the sale of their carbons for arc lighting, and carbon brushes, and their other manufactures.

Mr. C. F. Quicke, of 72, Finsbury Pavement, lately London business manager of the Okonite Company, has been appointed London agent of Messrs. Connolly Brothers, of Blackley, Manchester. We learn that Messrs. Connolly Brothers, who make a speciality of vulcanised rubber cables, have just received a large repeat order for this class of main cable from the Manchester Corporation, a previous order having been successfully completed and laid with satisfactory results for the Oldham Street extension.

Awards.—We learn that Messrs. Holland & Holland's exhibits of carriages at the Antwerp Exhibition, which took Grand Prix, were fitted with electric lighting by the Bristol Electric Safety Lamp Works. We also understand that after prolonged experiments, the new range-finding instruments, invented by Profs. Barr and Stroud, are all fitted with accumulators supplied by the same firm.

Mr. S. Howes, of Mark Lane, has been awarded a gold medal at the Antwerp Exhibition for his "Little Giant" double turbine and display of mill machinery. A gold medal and diploma of honour was also awarded the "Little Giant" at the World's Fair, Chicago.

Berliner Electricitäts Werke.—We are informed by the Electrical Company, Limited, that the annual report (1893-4) of the Berliner Electricitäts Werke, Berlin, contains the following figures up to the end of September, 1894:—Consumption of current supplied to the cable nets, 97,287 ampères, besides an additional 9,313 ampères on order, which will be shortly cancelled. The consumption of current during the year 1893 to 1894 was equal to 92,055,000 normal lamp hours for private customers, and 424,290 for street lighting, and for motors 570,421 kilowatt hours were used. At the end of June, 1894, 380 motors were connected, with a put-out of 1,364 H.P., and orders for 70 more motors, with an output of 300 H.P., are in hand. The total capacity of the station is 13,000 kilowatts. The Berliner Electricitäts Werke were designed and constructed by the Allgémeine Electricitäts Gesellschaft, of Berlin, whose sole agents for Great Britain are the Electrical Company, Limited, of Charing Cross Road, W.C.

Brighton-Rottingdean Electric Railway.—A local paper states that the work of the railway is making satisfactory progress, and it is hoped that the line will be open for traffic next Easter.

Crossley Telephone Company, Limited.—At an extraordinary general meeting of this company, held at 41, Piccadilly, Bradford, on October 18th, 1894, the subjoined extraordinary resolution, which was passed at the extraordinary meeting held on October 1st, was submitted for confirmation as a special resolution:—"That the Crossley Telephone Company, Limited, be wound up voluntarily under the provisions of the Companies' Acts of 1862 and 1867; and that Mr. Henry Edward Jeffree, of 30, Hallfield Road, Bradford, is hereby appointed liquidator for the purpose of such winding up."

Electro-Tanning.—Mr. L. A. Groth has removed to 88, Neckar Strasse, Stuttgart, and his system of tanning can be seen in daily operation in various tanneries.

"Engineers' Gazette."—We understand that the proprietors have arranged with Mr. Geo. N. Arnison, jun., of Sunderland, to be editor of this journal.

Failure of the Electric Light at the Foreign Office.—The Foreign Office was plunged into temporary darkness last Monday evening by the sudden failure of the electric light. As gas is not now used in the building, the collapse of the light caused some inconvenience.

The Secretary of the Westminster Supply Corporation has written to the daily papers stating that the failure was not due to any defect in the company's supply, but that owing to the melting of a safety fuse within the building, the lamps on one floor were out until a new fuse was inserted.

J. P. Rushworth & Co.—This firm has just completed an installation of 100 16-C.P. lamps, and a 60 ampère Harris dynamo, on the premises of John Riley & Sons, of Sunbridge Road, Bradford. They are also at present engaged fitting up two installations for the corporation supply at Huddersfield, *i.e.*, 30 16-C.P. lamps for Messrs. Kirby & Co., also 80 16-C.P. lamps for the Huddersfield Bazaar.

Lead Dust Accumulator.—In our last issue we omitted to state that Mr. G. Strauss, of 130, Queen Victoria Street, is the sole agent in Great Britain for the Gelnhausen Electrical Company for their accumulators, some of which can be seen at his address.

Lighting Plant.—We are informed that the plant at Billiter Buildings, Billiter Street, previously advertised for sale as a whole, is now to be disposed of in lots under the hammer. The plant has been only used for a short period, and therefore is stated to be, as a matter of fact, better than new, and we cannot but think that it is well worth the attention of engineers requiring additional power.

Poole's Electrician's Wire Gauge.—We have had several enquiries as to who are the manufacturers of this gauge, which we described in our last issue. These instruments are supplied by Messrs. W. T. Glover & Co., of 39, Victoria Street, Westminster, S.W.

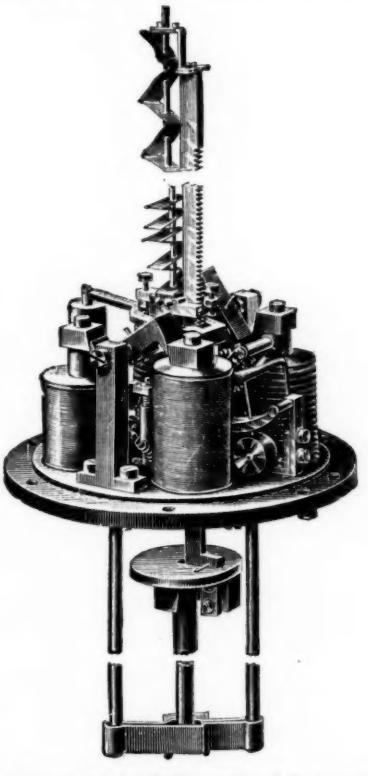
Presentation.—On Wednesday last, on the occasion of Mr E. Rutland's retirement from his position on the technical staff of Messrs. Johnson & Phillips, he was presented by his late colleagues and friends with a handsome gold watch and other small items, to mark the esteem and the goodwill which he had so well earned during his 10 years connection with the firm. Mr. Brockie made the presentation.

Price Lists.—The Waltham Electrical Engineering Company have sent us one of their price lists of some of the registered electric light fittings manufactured by them. Illustrations are given of fittings which have already been described in the Review.

From Messrs. Priestman Bros., Limited, we have received a circular giving a number of testimonials received from users of their oil engines, and a list of some of the public authorities and firms which have been supplied with the engines for electric lighting purposes.

We have received from Messrs. Mosses & Mitchell a small pamphlet dealing with their patent vulcanised fibre, and giving prices of same.

The "Luna" Arc Lamp.—The "Luna" arc lamp is of the "differential" type, and is made to work either on direct or alternating current circuits. The illustration shows the mechanism of the continuous current form, the construction of which is as follows:—On a steel spindle moving between two pin bearings are mounted two soft-iron armatures fixed at right angles to one another, and controlled respectively by series and shunt coils. On the same spindle is fixed a brass lever, which carries on one side a dashpot and on the other side a simple gear with pendulum escapement. The movement of the latter is regulated by a fork, an extension from which is free to move upwards, but whose downward motion is arrested on its coming in contact with an adjustable screw. A plated metal rack, which gears into the escapement, carries the top carbon, and is joined to the positive terminal by a flexible connection, consisting of a zig-zag copper band. The action of the lamp is as follows: The rack falls by its own weight, thereby moving the pendulum escapement until the two carbons touch. When the current is switched on, the series coils become excited, thereby moving their armatures in such direction as to cause the rack to be lifted up and the arc to be struck; at the same time the pendulum is locked, being pulled against the movable fork. As the arc is struck the shunt coils also get excited, becoming stronger and stronger as the length of car increases (through the burning away of the carbons), until they are stronger than the series coils. The lever is now moved downwards, and with it the pendulum and the fork, until the latter comes to rest upon the stop of the regulating screw. Any further depression of the lever releases the pendulum, which causes the rack to feed, the rate of feeding being about 0·2 millimetres for each swing of the pendulum. The series coils now in their turn increase in strength and again pull up the top carbon. It will be seen, therefore, that the rack, and with it the length of arc, is at any moment completely balanced by the respective forces of the series and shunt coils, a point absolutely essential to the steady burning of an arc lamp. We understand that the "Luna" lamps have been adopted by Her Majesty's Government. These lamps are also very extensively used on the continent, and are now being employed over here at a number of the theatres and music halls. The lamps are supplied by the Electrical Company, Limited, of Charing Cross Road, who have just brought out a new list illustrating and describing the various types.



The Midland Lighting Company v. Wood & Co.—In the Queen's Bench Division of the High Court last Friday, before Mr. Justice Cave sitting without a jury, the case of the Midland Lighting Company *v.* Wood & Co. came on for hearing. This was an action brought by the plaintiffs, who carry on business at Birmingham, to recover £105 4s. 1d., the balance of the price of certain electric fittings which were specially made by plaintiffs for the defendants, who were the patentees of certain electric lamps. The defence raised was that the goods were not according to sample, and that some of them were not delivered. Evidence was given as to the delivery of the goods, and the defendants not now appearing, his Lordship gave judgment for the plaintiffs for the amount claimed, with costs.

The Telegraph in British North Borneo.—The British North Borneo Company have made the following communication respecting the progress of the telegraph line across North Borneo:—"Eastern section trial trace 117 miles, permanent 24 foot trace, 32 miles."

Water-Power.—There have lately been a number of letters appearing in the newspapers published in districts which have not an electric supply station from correspondents whose attention has been drawn to the use of water-power for Worcester municipal supply station. Several of the correspondents in question recommend their local authorities to make use of adjacent water-power in a similar method. One of these places is Huntingdon, where we have been given to understand that for several reasons electric lighting will not be likely to gain a footing for many years to come. However, there is a splendid stretch of water-power running to waste in the Ouse, and there are also watermills standing idle which might with advantage be used for electric lighting purposes.

Wigston Electrical and Engineering Co., Limited.—This company has been formed and registered to trade as electrical and mechanical engineers, and has taken over the premises, patents, drawings and special plant of the late firm of Latimer Clark, Muirhead & Co., Limited (in liquidation). The new company has also engaged the services of the technical staff, and retains Mr. F. Thornton as general manager. The company has commenced business on the old premises of the company in Regency Street, Westminster, pending the erection of their new works at Wigston.

Bournemouth.—The Town's Interest Association, last Monday, resolved "that the members of the executive should make themselves conversant with the wording of the recent provisional orders relating to the electric lighting of Bournemouth, so as to be able to discuss the question in an exhaustive manner at next meeting."

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—Tenders are shortly to be invited for wiring the Municipal Buildings. The cost is estimated at £200. Mr. Murray, the electrical engineer, along with Mr. Bisset and Mr. Cran, has the matter in hand.

Liverpool.—Estimates are wanted for fitting up a 100 16-C.P. installation, including dynamo, also one arc lamp. Tenders to Messrs. Kauffmann, Lawson & Co., Fox Street.

Switzerland.—The Municipal Authorities of Pietikon, near Zurich, have just invited tenders for the electric lighting of the public streets.

Switzerland.—Tenders have just been invited by the Municipal Authorities for the establishment of a network of electric tramways in the town of Lugano.

France.—December 1st, 1895. The Municipal Authorities of Remiremoris (Vosges) are inviting tenders for the lighting of the town, either by gas or electricity, after September 30th, 1896, when the present gas lighting concession expires.

CLOSED.

Aberdeen.—The following tenders were sent in for wiring the new police offices:—

Shirras, Laing & Co.	£143 18 0
New & Mayne	186 0 0
Faraday Electrical Engineering Co.	265 0 0

That of Messrs. Shirras, Laing & Co. was accepted. A letter will be found in our correspondence columns referring to the figures here given.

Islington.—The following tenders were sent in for the erection of the central station. The site upon which the station is to be erected cost £19,000. The tender of Messrs. Macfarlane Bros. has been accepted for the buildings:—

Bush & Sons, £23,360 and £1,718 extra for glazed bricks.
Hall, Beddall & Co., £24,440 and £1,710.
Harris & Wardrop, £23,978 and £1,790.
Higgs & Hill, £24,484 and £1,764.
Holloway Bros., £23,210 and £1,938.
Lester & Co., £24,731 and £1,670.
Macfarlane Bros., £21,685 and £2,100.
Mattock Bros., £21,991 and £1,885.
J. T. Messon, £22.750 and £1,700.
Perry & Co., £23,229 and £1,682.
Rider & Son, £24,990 and £1,800.
L. H. & R. Roberts, £23,493 and £1,896.
W. Shepherd, £22,500 and £1,680.
G. S. Williams & Sons, £22,264 and £1,917.

The closeness of these tenders is very remarkable, and they should form an object lesson to the firms who tender for electric lighting.

London.—The tender of Messrs. Spurr, Inman & Co. has been accepted for the supply and erection of six new Lancashire boilers and accessories at the Deptford pumping station, for the London County Council, for £4,154 0s. 2d. They have also received the contract for the supply of four Lancashire boilers for the Abbey Mills pumping station, for the London County Council, for £2,037.

NOTES.

Telegraphic Communication Interrupted.—The island of Alderney is now isolated from the rest of the world, so far as telegraphic communication is concerned, a rupture having taken place in the cable connecting Alderney with Guernsey. The break is about mid-channel, and it is said will not be repaired until next spring. This will be unfortunate for the inhabitants, as during the winter months the mail steamer *Courier* goes there only twice a week.

Accident at Milford.—On Friday evening last an accident occurred to a man named Mulhall, who is in the employment of the Milford Electric Light Company. He had occasion to lower a 1,200 C.P. arc lamp at the end of Dublin Street, and while arranging the carbons he received a shock through short-circuiting, and was violently thrown to the ground, still retaining his grasp of the apparatus. A passer-by struck the wire with his walking stick, loosing it from Mulhall's grasp; he is now on the way to recovery.

Electrical Work at Paris.—The electric mains in Paris are for the most part laid along the principal streets. If any of the occupiers of houses in the side streets wish to become consumers, a derivation is established with lead-covered cables. To this practice must be attributed the little work that is being done in the way of laying electric mains. On the other hand, we are informed of a large number of private installations in the Champs-Elysées quartier. The Auer gas burner renders the present state of development of electric lighting somewhat stationary; several of the consumers wished to try the Auer burner. For some months they are, as a rule, very pleased with it; but then they see that if there is a small saving realised, the light is not so good, and that it is far from possessing the advantages of electric lamps.

Electrical Accidents in Paris.—In September a large number of fires and various other accidents occurred at Paris. The Auer Gas Burner Company, it is said, immediately sent to various papers notes attributing these accidents to electricity, but omitted to mention that if they really took place, the electrical installations had not been established under good conditions. First there was the fire at the Parisian Refinery, at St. Ouen. It was said that the fire originated from a wire, the gutta-percha covering of which had caught fire, and that the wooden distribution board had become ignited. Before we can express an opinion, we must know under what conditions the installation was established. But we may ask how a wire could become red-hot without the fuse melting, and how a board could become ignited if all the indispensable precautions had been taken. A gas explosion is also quoted, caused by an electric spark, owing to contact with the gas mains. Mention has also been made of the interruption that occurred in the lighting of the Théâtre de l'Odéon. These accidents are no doubt greatly to be deplored, but in most cases they are attributable to installations established under bad conditions, and badly maintained.

Alleged Damage by Vibration.—A Dublin landlord was the other day summoned by one of his tenants for the value of the furniture in one of the rooms tenanted by him. The landlord's agent, for the defence, attributed the collapse of the room to the vibration caused by the adjoining electric light works. The plaintiff was unsuccessful in the action.

French Cable Companies.—The *Journal des Debats* the other day made the following announcement:—"The Minister of Commerce, Ports and Telegraphs, with the sanction of the Council of Ministers, has signed a decree, dated October 27th, which authorises the French Paris-New York Telegram Company to transfer to the French Submarine Telegraph Company the rights and charges of the concession granted to it on January 7th, 1879, for the establishment of a submarine trans-Atlantic cable. This decision officially confirms and renders definitive the amalgamation of the two companies agreed upon by the meetings of their respective shareholders."

A New Electric Locomotive.—There is an electric locomotive in course of construction in Boston, Mass., which will meet, it is claimed, all the requirements for propelling railroad trains. It is an 8 horse-power machine, and is unique. The distinctive feature of the invention, says the Boston *Transcript*, is the substitution of a piston and cylinder in place of the usual rotary power. The cylinder is much longer than for steam purposes, and has in its interior a series of electro-magnets. The piston passes entirely through the cylinder, with cross-heads at either end. On the piston within the cylinder is a series of armatures of peculiar construction. On the axle of the driving wheels are commutators whose function is to apply and cut off the electric current, just as the eccentrics control the steam of a steam engine. The principle of the machine is the admission of the current to the electro-magnets in the cylinder, which are in advance of the piston rod, and by their action on the armatures the piston rod is moved forward. As the stroke is ended the current is cut off from the electro-magnets first excited and applied to those at the rear of the piston, giving it a reverse motion, thus maintaining a strong, regular motion. There is absolutely no back pressure from the electric current, while in a rotary motor this is estimated at 20 per cent. of the force applied. It is practicable to run the machine at 200 revolutions of the axle per minute, and with a driving wheel 8½ feet in diameter, and the crank pin 3 feet from the centre, there would be a 6 foot stroke under a full head of power. The machine is adapted to receive the electric current either by a trolley wire, a third rail in the track, or from a storage battery.

Medical Electrical Institute, Limited.—We cull the following timely comments from last Saturday's *Lancet*:—"In the *Financial News* of the 20th inst. there is an advertisement of the above projected company, which it is proposed to build upon the wreck of the notorious Medical Battery Company, now in liquidation, and which was associated with the name of Harness and others. As a speculative venture pure and simple we should not consider it worthy our notice, but since the avowed object and aim are to resuscitate a business the methods of which have lately been fully exposed in the law courts, and shown to be in some instances worthless and utterly devoid of a scientific basis, we cannot withhold a word of protest and warning. Moreover, in the prospectus it is stated that one object of the new company is 'to provide for and carry out, under the control and superintendence of a *duly qualified medical man*, the treatment of diseases by means of galvanic, electric, and mechanical appliances, &c.' Now it may not be generally understood by the public that for a medical man to lend himself to such a purpose would brand him with the stigma of charlatanism and quackery, and would subject him to the punitive powers of the General Medical Council. Are the persons responsible for the floating of this company ignorant of the fact that they are putting before their would-be shareholders a promise which they could not guarantee to fulfil? If not, they should clearly understand that though they might appoint a duly qualified medical man, the latter would be but the tool of a day, seeing that he would in quick time be stripped of his licence, as others at no distant date have been for similar offences."

Institution of Electrical Engineers.—The following papers are down for reading at the first meeting of the session, *i.e.*, November 8th, at 8 p.m.:—"Notes on Electric Tramways in the United States and Canada" (supplementary paper), by H. D. Wilkinson; "Electric Traction, with Special Reference to the Installation of Elevated Conductors," by R. W. Blackwell and Philip Dawson. These papers will be discussed, together with Mr. Wilkinson's original paper, "Notes on Electric Tramways," published in part 113 of the Institute Journal.

Lectures on Polyphase Currents.—A short course of lectures on polyphase current working will be given at Finsbury Technical College by Prof. Silvanus P. Thompson, on Mondays, at 8 p.m., through the month of November. The first lecture deals with polyphase generators, the second with the history and development of the rotatory field motor. The third is devoted to the theory of non-synchronous motors; and the series concludes with some account of the tests on modern types of alternate current motors, their construction, and methods of starting and regulation.

The Pacific Cable.—A despatch dated San Francisco, October 27th, says that "Mr. Mercer, of the British Colonial Office, and Mr. Sandford Fleming, the representative of Canada, have returned from Hawaii, where they have been negotiating with the Government of that country for the concession of a landing place and telegraph station for the projected Pacific cable. Mr. Fleming was interviewed on arrival here, and said that the Hawaiian treaty with the United States precluded the concession of any land or any special rights to any country other than America. The British Commissioners had agreed not to fortify the cable station, nor to create a naval station. Mr. Fleming added that it was understood Hawaii would appeal to Washington for permission to grant the privilege asked for by Great Britain in respect to the land concession. The Commissioners, while on their journey, inspected Bird Island, and made the necessary soundings in the vicinity. They will proceed from San Francisco to Washington to urge their case with the United States Government."

Notes on the Effects of High Frequency Discharges passed through the Body.—At the meetings of the American Electro-Therapeutic Association, Professor Elihu Thomson contributed some notes on this subject. He said he had been experimenting with alternating currents for a number of years. His early efforts in this direction are contemporaneous with those of D'Arsonval and Tesla. He said that much absurd talk had been made in the newspapers over the ability of persons to withstand hundreds and thousands or even millions of volts. "It is a very old experiment, of course, to insulate a person's body and charge and discharge the same with sparks 10 inches in length without special inconvenience. A person could be subjected to a charge or discharge at a high frequency, say, of 10,000 per second, and with a voltage of 100,000 or 200,000, and yet have a comparative absence of sensation during the reception and reversal of charges." Prof. Thomson stated that he has "never been satisfied with the vague explanations attributing immunity to the skin effects, or the flow of high frequency discharges, almost wholly on the surface of the conductor, instead of through its interior. On the contrary, the very nature of the tissues of the body would prevent the skin effect. The outside surface of the arm is fairly dry epidermis, which, on account of its high resistance, would prevent the passage of current, and the true dermal layer, though conducting, is of extreme sensibility, so that a concentration of current in the skin should rather enhance pain than annul it. That no condenser effect, as such, is the cause of the immunity, is proved by the simple consideration that two persons may have each an arm connected respectively to the electrodes of the high frequency apparatus, while if an incandescent lamp is held between them by the other hands, so as to complete the circuit of which the lamp is a part, the lamp is lighted, though the actual potential of the source may be so low as to give a circuit having no more than $\frac{1}{12}$th of an inch. The position of the lamp in the circuit forbids condenser action if the potential itself were not too low for such action."

Bolton Central Station.—On Wednesday evening the electric lighting was successfully inaugurated, the opening ceremony being attended by the usual festivities.

Errata.—In our issue for October 26th, 1894, page 492, in the article on "Earth Currents," in line 20, for "11 inches in diameter," read "11 millimetres in diameter;" line 43, for "Prof. C. Ritchie Smith," read "Prof. C. Michie Smith."

"In Honour of Electrical Science."—On Wednesday evening, last week, a large company of scientists, including a number of prominent electrical men, assembled at Fishmonger's Hall, at the invitation of the Fishmonger's Company, at a dinner given in "honour of electrical science."

Polytechnic Institution.—Thursday next, November 8th, will be the opening night of the photographic department of this Institution, which is situated at 309 and 311, Regent Street, W. There is to be a *conversazione* and distribution of prizes.

Storage Battery Litigation.—The Accumulator Company of Philadelphia (the owners in America of the Swan and other patents, known as the E.P.S.) have obtained a preliminary injunction, issued by Judge Lacombe, in the United States courts, against the manufacturers of the chloride storage battery in the U.S.A.

New Torpedo Boat.—Mr. Seymour Allan has invented a new submarine torpedo boat. A model which he has prepared is stated by an evening paper to act very well indeed. The model was actuated by electricity, and in obedience to the current it rose or sank, turned, reversed, or remained stationary. It was stated that a full sized boat would be able to remain stationary under water for three days. Trials of the vessel were recently witnessed by naval officers and others at Melbourne, Australia, and our contemporary considers it will be the means of revolutionising modern maritime warfare.

The Cassel Gold Extracting Company v. Cyanide Gold Recovery Company and others.—Mr. Justice Romer on Thursday, the 1st inst., announced that he would deliver his reserved judgment in this action within the next few days. The evidence was fully reported in our columns, but it may be recalled that the plaintiffs are the owners of certain letters patent granted to Messrs. Forrest and McArthur for improvements in obtaining gold and silver from ores by means of a cyanogen-yielding substance. The defendants deny infringement, and allege that the plaintiffs' letters patent are not valid.

Accident at the Halles Station.—Last September an accident, which might have had serious consequences, occurred at the Halles Municipal Station. A steam pipe burst, and all the steam escaped. The machines were stopped at once, but the service was carried on for a little while by the accumulators. After years of working, accidents of this kind ought not to occur, especially at a municipal station, where the expenditure is not restricted, and where fresh additions are continually being made to the plant.

Lectures.—The first of a series of popular science lectures was given at Scarborough on Tuesday last week, under the auspices of the University Extension Committee, by Prof. J. A. Fleming, his subject being "Applications of Electricity; the Universal Servant."

Mr. McDonald, M.A., B.Sc., delivered a lecture recently at Leven on "Electricity as Applied to the Arts," in connection with the opening of an electrical class started by the County Council.

On Friday last, Prof. Lambert, M.A., &c., delivered a lecture on "Artificial Lighting: Its Theory and Practice," at the Folkestone Town Hall, with special reference to gas and electricity.

CITY NOTES.

The Petroleum Engine Company, Limited.

THE directors' report, to be submitted to the shareholders at the meeting on November 7th, at 3 o'clock p.m., states that for the year ending June 30th, 1894, the accounts show that the royalties received for the year amount to £751 0s. 6d. The directors regret that the modifications made in the agreement with the company's licensees 12 months ago have not had the immediate beneficial effects which were anticipated. This, they believe, is largely due to the unprecedented stagnation in trade throughout the country during the past year. The directors are unable to recommend the payment of a dividend for the past year, and consider it more prudent to carry forward the balance of £723 7s. 8d., standing to the credit of the income and expenditure account, to the next year's account. In view of the unfavourable times the directors propose to forego for the past year the remuneration to which they are entitled, as prescribed by the articles of association, and it will be seen from the accompanying accounts that no charge has been made for the services of the board for the year under review. The retiring directors are Mr. Henry Pawson and Mr. Ernest Moreton, who are eligible for re-election. The auditors, Messrs. E. L. Ernest & Co., retire, and are eligible for re-election.

Eastern Extension, Australasia, and China Telegraph Company.

THE forty-second ordinary general meeting of the shareholders of the above company was held on Wednesday at Winchester-house, Old Broad Street, Sir John Pender, G.C.M.G., M.P., in the chair.

The report and accounts having been taken as read,

The CHAIRMAN, in proposing their adoption, said that the gross receipts for the half year under review amounted to £247,681, against £257,986 for the corresponding period of 1893, showing a decrease of £10,305. The loss on exchange had been exceptionally heavy during the half year—amounting to £21,000—otherwise the revenue would have shown an increase. Since May 1st the rates of collection at the Straits Settlements, and other portions of the China traffic, had been raised, and as soon as they were in a position to do so, they would adjust the tariff for the rest of the China traffic, so as to obtain the full currency equivalent to their sterling charges. The working expenses had amounted to £80,295, against £78,299 for the corresponding period of 1893, showing an increase of £2,066, which was chiefly due to the opening of the two new stations at Labuan and Serabaya. The usual interim dividend, at the rate of 5 per cent. per annum, had been paid for the half year, amounting to £62,000, and the balance of £68,457 was carried forward to the next account. They had now had three years' working under the Australian tariff guarantee arrangement—the third year expiring on April 30th last—and the accounts showed that the loss on that year's working had amounted to £12,384. Under the arrangement, one half of that loss was borne by the guaranteeing governments, and the other half by the associated companies. During a portion of last year, however, an abnormally large traffic was carried in connection with the reconstruction of many of the Australian banks, and, as far as the figures at present showed, a much larger loss would accrue in the current year. As they knew, things were not in a very satisfactory state in Australia; the colony having passed through a very severe commercial crisis; but the darkest cloud was not without its silver lining, and without a doubt, sooner or later, they would see a "boom" arise in the colony, and all the vitality and energy which it had shown in the past would be again exhibited in the future. Referring to the Pacific cable, Sir John said the question was now apparently ripening, and the Canadian Government was very anxious to see the scheme carried out. There had been a meeting in Australia, and a conference had been held at Ottawa, and so far as he could understand it, the net result of that conference was that they were to find out the best water in which to lay a submarine cable, and after that point had been ascertained, tenders were to be invited, and the cost of the work was to be submitted to the various governments interested. He was not opposed, neither were any of his colleagues on the board, to the laying of submarine cables, but they wanted them to be laid in a way that would benefit the public generally, and where there was a decided want existing. But at the present moment we had telegraphic communication with Australia, probably second to no telegraphic system in the world—there was nothing that the people wanted to know in Australia at the present time that could not be obtained by telegraphic communication. Still, if the various governments agreed to lay a cable, it was not the business of the company to oppose, beyond protecting their interests. He had always said that should a cable be laid, looking to the experience they had in the matter, the governments would be wise if they consulted them, not only as to the way it should be laid, but also as to the maintenance of the cable. Any manufacturer could lay a cable, but it was not everyone that could maintain it. The maintenance of the cable was the great secret, and until they knew where the cable was to be laid, they could not be expected to give an accurate idea of what it would cost to maintain. He thought the Canadian Government was going a little beyond its instructions in asking for tenders, because they could not accept any tender until they had decided where the cable should be laid. When it was decided that a cable should be laid, he thought they might rely upon it that they would have something to do with it. Shortly after the last meeting they completed the cable from Singapore to Hong Kong *vid* Labuan, and he had always said that a duplicate line for either commercial or political purposes was a necessity, and that had been proved recently, for had they not had that duplicate cable they would have been shut out from connection with Hong Kong through the Straits. He believed that new line would be of great value to them in the future, and a great protection to their interests.

Lord TWEEDDALE seconded the motion.

Mr. NEWTON suggested that the vote of thanks to the staff might well include a bonus to be distributed among them.

The CHAIRMAN, in reply, said that when it was remembered that the company had over 1,200 people in its employ, it would be apparent that to give them all a bonus would require a very large sum. They dealt very liberally with their employés, and he had never heard any complaint.

The report was then adopted, and the proceedings closed with a vote of thanks to the chairman and directors.

Monte Video Telephone Company.

Mr. HERBERT WARD (chairman) presided over the annual general meeting of the shareholders of the Monte Video Telephone Company, held at Gresham House, Old Broad Street, on Wednesday morning, and in moving the adoption of the report, said that looking at the result of the year's working they would observe that the net profit, £6,902 15s. 11d., was slightly in excess of the net amount last year. The subscriptions had increased by £460, and the item under that head to the credit of profit and loss account was still further increased by the rent for the letting of the central premises in Monte Video. Previously that rent, being a small amount, had always been credited to the general rent account, which went to the reduction of working expenses. It had been thought advisable to in future separate those items, and take it direct to profit and loss account. That explanation would account for the apparent slight increase in their working expenses, which, after allowing for that item of rent, were only £4 in excess of last year, when they would recollect the expenses were reduced to the lowest level compatible with efficiency, and that notwithstanding the increase in subscriptions. The increase in the London office expenses was accounted for by the addition last year to the number of directors. Income tax was slightly lower, and the loss on exchange of £13 last year was turned into a gain of £48. Coming to the important item of the valuation of materials in hand, these materials had for some time been standing in the books at a higher figure than their intrinsic worth. The instruments included a number of instruments taken over from the Gower-Bell Telephone Company, and they were becoming obsolete, and in view of the large depreciation in the value in the books, the board had no alternative but to deal with the matter in that year's account. After careful consideration, it was decided to write off £1,345 11s. 6d., and take out of the depreciation fund a further £1,000 for the same purpose, thus bringing the value of the stock to an amount considered justifiable by the general manager, which was £3,494 12s. 10d., which now stood as an asset in the balance-sheet to-day. On the subject of bad and doubtful debts, he was glad to say they had made none in the period under review, which was evidence of an improved state of things, which, if it continued, would be sure to make itself felt in all branches of trade. The amount outstanding for subscriptions on July 31st was slightly in excess of that last year, but their manager endorsed all the list as recoverable. At the same time, the directors thought it their duty to set aside £509 to cover any loss which might arise. The number of their subscribers continued to be well maintained, and showed, in fact, an increase of 46 at the end of July. Altogether, he thought it might be safely said that the company was progressing, and with greater activity in business circles in Monte Video there was little doubt that everything would go ahead. By providing a reserve fund of £1,000 the company was given additional strength, as it was an absolutely liquid asset, and the fact that they were able to put that £1,000 aside and pay a dividend of 4 per cent., compared very favourably with other South American enterprises at the present time.

Mr. JONES seconded the resolution, and the report was adopted.

Mr. JONES moved the re-election of Mr. Ward as a member of the board.

Warrants payable on November 1st for the 4 per cent. dividend on the preference share capital for the year ending July 31st were posted on Wednesday.

The Western and Brazilian Telegraph Company, Limited.—The board has decided that after placing £2,000 to the reserve fund, and £5,000 to the debenture redemption fund, subject to audit, to recommend at the forthcoming meeting a dividend at the rate of £2 per cent. per annum, free of income tax, for the six months ended June 30th last, carrying forward £5,630. This dividend will be payable as follows: 3s. per share to the ordinary shares, and 3s. per share to the preferred ordinary shares. The transfer books will be closed from Tuesday, November 6th, to Friday, November 16th, both days inclusive.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending October 28th, 1894, amounted to £948; week ending October 29th, 1893, £850; increase, £98; total receipts for half-year, 1894, £14,811; corresponding period, 1893, £13,806; increase, £1,005.

The Liverpool Overhead Railway Company. The traffic receipts for the week ending October 29th, 1894, amounted to £901; corresponding week last year, £583.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 26th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brasilian Telegraph Company Limited, were £2,975.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation, October 24th.	Closing Quotation October 31st.	Business done during week ended October 31st, 1894. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	...	...	...	102 —105	102 —105	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 12s.	£2 15s.	£2 11s.	38 — 41	35 — 37	38	37
2,993,560£	Do. do. 6 % Pref.	Stock	£5 5s.	£5 10s.	£5 2s.	74½ — 75½	71 — 72	73⅝	71¼
2,993,560£	Do. do. Defd.	Stock	...	...	...	6¾ — 7¼	6¼ — 6⅝	6⅝	...
130,000	Brazilian Submarine Teleg., Ltd.	10	8 % §	6½ % §	6½ % §	12¾ — 13¼	12⅜ — 13	12⅛	12⅛
75,000£	Do. do. 5 %, repayable June 1906	100	...	...	...	110 —114	110 —114	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 40,000	5	... §	10% ‖ §	... §	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	135 —145	135 —145	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	3½ % §	2 % §	2 % §	⅛ — ¼	⅛ — ¼	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12½ — 13½	12½ — 13¼	13	12⅞
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,931	Direct Spanish Teleg., Ltd., £4 paid	5	4½ %	4 %	4 %	4¼ — 4⅜	4¼ — 4⅜	4⅜	...
6,000	Do. do. 10 % Pref.	5	10 %	10 %	10 %	9½ — 9⅝	9¼ — 9⅜	...	...
30,000£	Do. do. 4½ % Debs of £50, Nos. 1 to 1,600	...	...	...	...	105 —108%	105 —108%	...	...
60,710	Direct United States Cable, Ltd., 1877	20	3½ % §	3½ % §	2⅜ % §	8½ — 9	8 — 8½	...	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½ % §	6½ % §	6½ % §	15⅞ — 16	15⅝ — 16	15⅝	15⅜
70,000	Do. 6 % Pref.	10	6 % §	6 % §	6 % §	16¾ — 17¼	16½ — 17	16⅞	...
102,100£	Do. 5 % Debs., repay. August, 1899	100	...	...	...	106 —110	106 —110	...	...
1,297,837£	Do. 4 % Mort. Deb.	Stock	...	...	...	118 —121	118 —121	120	119½
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	16 — 16¼	15⅞ — 16⅛	16⅛	15⅞
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	...	...	...	103 —106	103 —106	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	...	...	...	103 —106	103 —106	...	...
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	116 —120	116 —120	...	...
95,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	...	...	...	103 —106	103 —106	104½	...
129,100£	Do. do. do. to bearer, 2,344 to 5,500	...	...	...	...	103 —106	103 —106	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 2,016, red. 1909	100	...	...	...	104 —107	104 —107	104½	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	...	...	...	109 —112%	109 —112%	110	...
180,227	Globe Telegraph and Trust, Ltd.	10	5¼ % §	4⅜ % §	4⅝ % §	8⅞ — 9⅛	8⅝ — 8⅞	9⅛	8⅛
180,042	Do. do. 6 % Pref.	10	6 % §	6 % §	6 % §	15⅞ — 16¼	15½ — 16	16	15⅞
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅝ % §	8⅝ % §	8⅜ % §	20½ — 21½	20½ — 21¼	20⅞	...
190,000£	Do. do. do. 5 % Debs.	100	...	...	...	105 —108	105 —108	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	46 — 48	46 — 48 xd	...	...
37,548	London Platino-Brazilian Teleg., Ltd.	10	...	...	...	5 — 7	5 — 7	...	...
100,000£	Do. do. 6 % Debs.	100	...	...	...	107 —110	107 —110	107¼	...
15,000	Monte Video Teleph. Co., Ord., 1 to 15,000	5	...	...	...	¼ — ¾	¼ — ¾	...	...
28,000	Do. do. 6 % Pref., 1 to 28,000	5	...	...	...	1 — 2	1 — 2	...	...
484,597	National Teleph., Ltd., 1 to 438,984	5	6 % §	5 % §	5 % §	4⅞ — 5⅛	4⅞ — 5⅛	5 1/16	4 15/16
15,000	Do. 6 % Cum. 1st Pref.	10	...	...	...	15 — 16	15 — 16	15⅝	...
15,000	Do. 6 % Cum. 2nd Pref.	10	...	...	...	14 — 15	14 — 15	..	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 90,950	5	...	...	...	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	5⅛
1,000,000£	Do. 4½ % Deb. Stock Prov. Certs. ...	...	...	...	...	110 —113	110 —113	...	...
48,800	New Teleph., Ltd., 25,901 to 74,700; £4 paid	10	...	...	...	... — ...	... — ...	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	...	1/16 — 2/16	1/16 — 1/16	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	...	...	...	104 —107	104 —107	...	...
11,839	Reuter's Ltd.	8	5 %	5 %	0 %	3 — 5	3 — 5	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	105 —110	104 —109	105½	...
58,000	United River Plate Teleph., Ltd.	5	...	...	...	2 — 3	2 — 3	...	...
146,733£	Do. do. 5 % Debs.	Stock	...	...	...	88 — 94	88 — 94	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	4 %	..	0 %	3 — 5	3 — 5	...	...
249,900£	Do. do. do. 5 % Debs.	100	...	...	...	100 —103	100 —103	...	...
30,000	West Coast of America Teleg., Ltd.	10	...	...	...	1½ — 2½	1½ — 2½	2¼	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	...	...	...	101 —106	101 —106	...	...
64,242	Western and Brazilian Teleg., Ltd.	15	4 %	2½ %	2½ %	8½ — 9	9 — 9¼	9¼	8 1/16
33,129	Do. do. do. 5 % Cum. Pref. ...	7½	...	...	...	6⅝ — 7	6½ — 7	6¾	6 1/16
33,129	Do. do. do. 5 % Def.	7½	3 %	...	...	2¾ — 3¼	3 — 3⅛	3¼	3
171,900£	Do. do. do. 6 % Debs. "A," 1910 ...	100	...	...	...	106 —109	106 —109	...	...
214,800£	Do. 6 % Mort. Debs., series "B," red. Feb. 1910	100	...	...	...	106 —109	106 —109	...	...
88,321	West India and Panama Teleg., Ltd.	10	¼%	¼%	⅜%	1¼ — 1⅜	1¼ — 1⅜	1¼	...
34,563	Do. do. do. 6 % 1st Pref. ...	10	...	...	...	10¾ — 11¼	11 — 11½	11¼	11 3/16
4,669	Do. do. do. 6 % 2nd Pref. ...	10	...	...	...	9 — 10	9 — 10	...	...
80,000£	Do. do. 5 % Debs. (1917) No. 1 to 1,000	100	...	...	...	108 —111	108 —111	...	...
$1,211,000	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	...	...	...	115 —120	115 —120	...	...
166,900£	Do. do. 6 % Ster. Bonds.	100	...	...	...	102 —104	102 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply, 1 to 6, 215 to 718, and 10,001 to 30,000	5	...	5 %	4½%	4½ — 5½	4½ — 5½	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	...	13 — 14	13 — 14	13 1/16	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	...	6 %	6 %	14½ — 15	14½ — 15½	15	14 1/16
100,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	131 —133	131 —133	...	...
50,000	†Liverpool Electric Supply, all paid	5	4½%	5 %	5 %	6 11/16 — 6 15/16	6⅝ — 6⅞	...	...
49,900	*Metropolitan Electric Supply, Ltd., 6,101 to 50,000 ...	10	1 %	2 %	2½%	9¼ — 9⅜	9¼ — 9⅜	9⅜	9½
100,000£	Do. 5% Deb., 1 to 10,000 in bonds of £10, £20, £40	...	...	...	...	... — ...	... — ...	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	...	5½ — 6½	5½ — 6½	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-18,780	5	8½%	7½%	4½%	7½ — 8	7⅝ — 8¼	7⅞	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8¾ — 9¼	8⅜ — 9⅛	9⅛	8¾
59,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	...	3½%	4 %	6½ — 7	6¾ — 7⅛	7 1/16	7

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation, Oct. 24th.	Closing Quotation, Oct. 31st.	Business done during week ended Oct. 31st, 1894. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000	3	...	6 % §	6 % §	2½ — 2⅝	2⅝ — 2⅝	2 11/16	2⅝
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	....	6 % §	6 % §	2¼ — 2⅜	2½ — 2¾	...	...
125,000/	Do. do. 4½ % Deb.	Stock	...	...	...	111 —114	111 —114	...	...
630,000/	City and South London Railway	Stock	...	⅝%	⅝%	36 — 38	36 — 38	36½	...
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	7 % §	7 % §	7 % §	2 — 2½	2 — 2½	...	...
50,000/	Do. do. 5 % 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	...	...	...	94 — 99	94 — 99	...	...
120,000	Electric Construction, Ltd., 1 to 120,000	2	...	...	...	¼ — ½	⅜ — ⅝	⅜	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	...	...	...	1½ — 2	1½ — 2	...	...
100,000	Elmore's French Patent Cop. Deposg., Ltd, 1 to 66,750 ...	2	*nil*	*nil*	*nil*	5/16 — 7/16	5/16 — 7/16	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil* ¶	*nil*	*nil*	1⅝ — 1⅞	1⅝ — 1⅞	1⅞	1⅝
67,385	Elmore's Wire Mfg., Ltd., 1 to 67,385, issued at 1 pm. ...	2	*nil*	*nil*	*nil*	1½ — 1⅝	1½ — 1⅝	1⅝	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	*nil* §	½ — 1¼	½ — 1¼	...	...
9,600/	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	...	...	6½ — 7½	6½ — 7½	...	...
6,837	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	5 %	8 — 9	8 — 9	8 13/16	8⅝
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	12½%	24½ — 25½	24½ — 25½	25⅜	24¾
200,000	Do. do. do. 4½ % Deb., 1896	100	...	...	...	102 —104	102 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	...	1 %	7 15/16 — 8 1/16	8 — 8½	8 1/16	...
6,295	† Do. do. Pref., £8 paid	10	...	...	...	13 — 13¼	13 — 13¼	...	...
	Swan United Electric Light, Ltd.	...	11 % §	10 % §	7½% §	... — ...	... — ...	...	...
37,250	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	20 %	41 — 43	41 — 43	42⅜	41¾
150,000/	Do. do. do. 5 % Bonds, red. 1894	100	...	...	...	106 —109	106 —109	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £2 paid ...	10	...	...	...	2 — 2¼	2 — 2¼	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5¼—5⅜.
Electric Construction Corporation, 6 % Debentures, 87—92.
Electric and General Investment, shares of £5 (£1 paid), 1¾—2¼.
House-to-House Company (£5 paid), 1—1½.
Do. do. 7 % Preference, of £5, 5½—5¾.
Do. do. 6 % Debentures of £100, 101—103.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 4⅞—5¼; 1st Preference Cumulative 6 %, £5 (fully paid), 6½—6⅝.
Liverpool Electric Supply, £5 (fully paid), 6⅜—6½.
London Electric Supply Corporation, £5 Ordinary, ⅞—1⅛.
Queen Anne's Mansions Lighting and Heating Company, 6 % £100 Debentures, 101—103.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares (£4 10s. paid), 4½—4⅝.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

HYDRO-ELECTRIC METHODS (PHYSICS AND APPLIANCES).

By H. Newman Lawrence, M.I.E.E.

(*Read September 26th*, 1894.)

The term, "hydro-electric methods," is, I take it, but a sort of modern glorified edition of the old time "electric baths." The advantage of its adoption seems to lie mainly in the fact that it offers to the lay mind a halo of obscurity, through which there is little chance of recognising any connection with so common and so medically despised a "method" as the electric bath.

Judging from what I have seen and heard, the medical profession have very little respect for electric baths in America, and are content, for the most part, to leave the administration of them to the attendants of Turkish baths and similar institutions, regarding the whole business as either a fad, or rank quackery.

Looking at the matter as an electrician, it seems to me baths, and especially the modern developments now designated hydro-electric methods, are worthy of better attention and study. For, if it be granted that physicians sometimes wish to place their patients under electric influence either local or general (and the very existence of this Association proves this to be the case), it is certain that one way by which this may be done is by electrised water, and accomplished by it, moreover, in a manner widely differing from other "methods" as to physical conditions.

Where physical conditions differ it is reasonable to suppose that physiological and pathological resultant influences may differ also, therefore, without in any way trenching upon the therapeutic value of these methods, it may be advantageous to consider briefly some of the physical conditions and problems of hydro-electric therapy.

The questions here dealt with, in accordance with the request of your secretary, are those relating to the use of constant current only, though it is manifest that it will be impossible to avoid going over some ground which is also common to the use of other forms of current.

The subject seems to divide itself into the following heads:—

(*a*) Apparatus required.
(*b*) The current employed.
(*c*) The methods.
(*d*) The patient (considered electrically).
(*e*) Problems.

And I will ask your attention to each in turn for a few moments. To consider them fully would take more time than lies at my disposal, but I have endeavoured to set forth an outline based upon broad principles, fundamental facts, and practical experience, which may prove useful in assisting any member of this Association who desires to turn his attention to the subject.

(*a*) *Apparatus.*—A bath tub of porcelain, slate, or wood, or, perhaps, of compressed paper—anyway, of *non-conducting material*, if it is intended to use it for dipolar baths.

The German pattern of bath tub is of oak, ovoid in shape, 4 feet 10 inches long, and 2 feet 6 inches wide; height at head, 1 foot 11 inches; at foot, 1 foot 5 inches. I have found in practice that the tub may be conveniently a few inches longer, and 3 or 4 inches narrower.

Electrodes in the German baths are fixed in various positions, and communicate with a switchboard by means of wires or conducting rods passing through the sides of the tub. This perforation for conductors of the sides of the tub always seems to me a source of weakness. However carefully cemented, they often leak water sooner or later, and when once fluid leakage commences, electrical leakage cannot be prevented.

I much prefer electrodes which may be placed in the water in any position required, and connected by insulated wires to terminals outside the bath tub. These, if of suitable size, may be made to answer all the purposes of the fixed German electrodes, and entirely obviate the objections above referred to. An adjustable band of strong webbing, to support the shoulders when the patient reclines in the bath, having leather straps and buckles, or loops and buttons, to regulate its length, is a convenient adjunct to the bath tub. Of electrical apparatus besides the battery or other source of supply, a switch board, a cell collector or rheostat, or both, and a milliampère meter reading up to 300 m.a, are necessary.

I have dealt more in detail with the electrical apparatus, under the head of current employed, but it may be well to state here that any such apparatus used should be of the best description. It need not be elaborate, but it *must be good* and *reliable*. Such apparatus may be rather costly as regards first outlay, but once purchased and properly installed, it will outlast several sets of inferior quality, besides being throughout far more satisfactory to work with.

(*b*) *Current Employed.*—This, by the conditions of our programme, must be what is known as constant or continuous current, but the source of supply may be either a battery or a dynamo, or as drawn from the street lighting mains.

Battery.—If a battery be used it must be of sufficient power, *i.e.*, it should consist of 40 to 50 cells having an E.M.F. of not less than 1 volt per cell, and these cells should be of fair size. Three-pint or two-quart Leclanché cells will do very well, or any similar simple kind of cell, but complicated and not-get-at-able makes should be avoided. Of course, if larger cells are available, they may be used, but it must not be overlooked that the size of the cell does not determine its E.M.F., therefore no increase of size will do away with the need for a number of cells. At least 40 cells of any kind are

needed, be their size great or small; but large cells possess more current capacity, and therefore will *last longer*, in proportion to their size.

With a battery the means of control are generally either a cell collector or a rheostat, or a combination of the two.

All control should allow of very gradual increase and decrease of the current. A cell collector, therefore, should not switch on more than two cells at a time. Even these small steps must be made without sudden jerks, or the least semblance of shock to the patient in the bath, and this is extremely difficult to obtain in a cell collector. I have tested many, and cannot say that I have found one which satisfactorily overcame this difficulty.

A rheostat, on the other hand, of sufficient power, put in circuit with all the cells, becomes in this respect a perfect controller, but is open to the objection, recently brought forward, that current passed through it is *more painful*. Because all the E.M.F. of the battery passes to the patient, the total energy administered (for an equal c − s) is greater, and hence more pain may be produced. To what extent this objection holds good I am not in a position to say, but should expect it to be somewhat counter-balanced by the therapeutic advantages of the increase of total energy, while at the same time it is obvious that less c − s may be used, and so the total energy made the same as it would be with greater c − s and lower E.M.F.

A combination of both cell collector and rheostat is sometimes recommended, and may be made to obviate both the difficulties above referred to, though its use is somewhat complicated, and in the hands of an ignorant and careless operator, may be distinctly dangerous. As an illustration of the latter point, suppose the cell collector acts by 10 cell steps, and the rheostat controls within such steps, it will be necessary to move the rheostat switch, so as to put in much more resistance, previously to switching on 10 more cells, in order to prevent too great an influx of c − s; a double process of switching, which could very easily be muddled, so that the patient receives a severe shock.

Dynamos.—In institutions, hospitals, and other large establishments having their own electric plant for light and power, the current so generated may be employed for hydro-electric purposes, provided proper precautions are observed to prevent accidents. On no account should it be considered safe to pass such currents direct through a bath with a rheostat *only* in circuit. The currents used in the dipolar bath are large (sometimes 200 or more milliampères), and their sudden break, or increase, might have very serious effect upon the patient. There are, however, controllers in the market which are much more than simple rheostats, and in accordance with a suggestion, first made, I believe, by Dr. W. S. Hedley, of Brighton, England, in the *Lancet*, April 9th, 1892, include a special safety automatic cut-out and a *shunt circuit for the patient*. The shunt, or divided circuit, is a very important safeguard, for by the suitable adjustment of resistance in the two arms, the current in the patients' circuit may be made any desired proportion of that in the main circuits, and the automatic cut-out effectually prevents the passage of any greater current than the maximum to which the apparatus may be set for the time being.

M. Gaiffe, of Paris, has introduced a controller based upon the divided circuit, which is very simple. To the best of my recollection, it consists of two arms of moderate resistance, upon which move sliding contacts forming the terminals of the patients' circuit. By adjusting the contacts the E.M.F. of the patients' circuit may be anything from 1 or 2 volts up to the full voltage of the supply.

Street Mains.—In using the current from the street supply mains, the methods of control are those given for use in institution installations. The two cases are almost identical, and though the E.M.F. of the supply may differ, yet it would in all cases be greater than that required for hydro-electric applications, and therefore would have to be controlled.

General Precautions.—In all electric bath installations it is absolutely necessary to pay great attention to insulation of all leads and conductors. Water is a fairly good conductor, and metal pipes are excellent conductors. Where electric light leads are about in the same building, it is very common to find an "earth" or "ground" more or less marked, the consequences of which *may be very serious*.

I have seen a patient when in the electrised water receive quite a sharp shock on touching one of the water taps that supplied the bath, and this though, on careful testing, it was found that the insulating of the bath installation itself was perfect.

In order to obviate this risk, I recommend that the water taps, and any others in metallic connection with the earth, be placed so far out of reach that no person can touch them when in the bath, or, if they must be near, that they be made of porcelain or glass, or at least well covered with some insulating substance.

Damp woodwork, whether of wall, floor, or bath casing, is a fruitful source of electrical leakage, though *dry wood* is in most cases a sufficient insulator.

All switches, controllers, measuring instruments, &c., should be placed well out of the range of splashes, and may be advantageously protected by a box with glass case front.

(*c*) *Methods.*—These may be dealt with under two heads, viz., dipolar and monopolar. The older forms of electric bath seem to have been, with little, if any, exception administered with both polars in the water, hence the name dipolar. There are varieties of the dipolar bath in which one of the electrodes is brought into contact with the patient's skin, and which, therefore, may to some extent be called monopolar, but it seems to me more correct to class all methods as dipolar where the electrodes are *placed under water*, no matter whether they be also *in contact* with the patient or not. It follows that monopolar baths or methods are those in which only one electrode is placed in the water. The electric douche may be either dipolar or monopolar, but it is more generally the latter.

Dipolar.—The dipolar bath consists in the complete immersion of the body in some conducting fluid, usually water, and the passage of a current through the composite conductor, fluid, and body by means of electrodes immersed in the fluid, and generally kept apart from the patient's body. Sometimes one or both the electrodes are made to touch the patient while still kept under water, with the idea of concentrating the lines of force at a given spot.

Monopolar.—In this form of bath one electrode only is used in the bath water, and the other is placed upon some part of the body not immersed. By this means either pole may be made the more active by concentrating the current at the non-immersed pole, and widely diffusing it at the immersed pole. For instance, if a patient be sitting in a bath tub full of water, and one electrode be placed in the water while the other is attached to his shoulder, the current will be diffused more or less over the whole of the immersed portion of the body; but the entire current, be it great or small, must pass through the shoulder under the other electrode, and is, therefore, concentrated upon an area many times smaller than that of the immersed body.

The monopolar form of bath may be used under circumstances which preclude the dipolar, for, while the latter requires a bath tub of considerable length and depth, the former may be efficiently administered with a site bath, or even a good-sized basin and a sponge. A little water in the tub or basin, covering a plate electrode, forms the diffusing pole, and the sponge, duly connected electrically, makes a convenient concentrating electrode. The patient sits or stands, as the size of the vessel permits, while the sponge electrode is applied to such parts as need special localisation of current, or is passed gradually over the whole body, so that each part in its turn receives the electric stimulus.

It will be readily understood that both forms of bath are capable of many variations to suit special cases; general conditions only are here referred to.

The Douche.—For a long time it was doubted, in England at any rate, if electric currents could be administered to the body by means of fluid douches in any other form than in one strong jet or stream. I remember having some correspondence with the late Dr. W. E. Steavenson, physician of the Electrical Department at St. Bartholomew's Hospital, London, on the subject, and in offering to prove to him that, with a properly constructed rose or sprinkler, electrised spray might be obtained. Unfortunately, the early death of that distinguished and careful electro-therapist prevented the proposed demonstration. Shortly after, however, I was able to prove the matter to Dr. W. S. Hedley, with the result that some interesting experiments, which leave no doubt on the subject, are published in his admirable work on "Hydro-Electric Methods in Medicine." All that is necessary to ensure that the water or other fluid is electrised when it reaches the patient, is to have the nozzle so constructed that the jet or jets of water form *continuous streams* for a reasonable distance after they leave the metal conductor within the nozzle. A little attention to the mechanical construction of the nozzles will secure this. Of course, *broken up spray will not* conduct the electric current any more than broken up copper wire would do. There must be fluid continuity if we would have electric continuity. Dr. Hedley* records that with a 2-inch rose nozzle, having 49 perforations, he was able to administer 5 ma. of continuous current to a patient when the nozzle was held 1 inch from the body, with plain water. When salt was added to the water, 7·5 ma. passed over one inch and a half, with that particular nozzle, while with a single jet nozzle he passed 20 ma. over 18 inches. With coil currents the effects were much more marked, a telephone in circuit indicating the presence of current within the stream of water over great distances.

Measuring instruments, or at least current indicators, are a necessary part of any electric douche plant, for without them it is impossible to know to what extent the apparatus is working, or even if it be working at all.

Speaking from personal experience and numerous observations, I think the douche application stands alone as a means of producing maximum concentration and localisation of current with minimum pain. It is essentially an instrument of precision, and in skilful hands is capable of graduated and modulated effects through the widest range. It is suited to internal as well as external applications, and owing to the perfect way in which fluids penetrate the interstices of the orifices of the body and the electrisation of the whole fluid, the electric douche forms a sure means of electrising parts which could hardly be brought under the influence of the current by any other form of electrode. I am strongly of opinion that the electric douche is worthy of careful attention and test by physicians, especially where internal electrisation is required, and I look forward with pleasurable anticipation to the paper by Dr. Cleaves, who, I understand, has found the electric douche a most valuable adjunct to other methods in certain cases

(*d*) *The Patient (considered electrically).*—Of course, it is manifest that the usual figures given for the resistance of the human body do not hold good when the body is immersed in fluid. Roughly speaking, the greater the portion of the body immersed, the greater will be its conductivity and the less its resistance, but other factors have their influence.

The body with dry skin possesses resistance several hundred times greater than that of plain water, at ordinary bath temperature, say 95° F. The difference is still greater when medicated fluids are considered.

The resistance of the body rests mainly in the outer skin. Consequently, if the body be immersed in either plain or medicated fluid, its resistance will be reduced almost immediately, and after being well soaked in the fluid, the resistance may be brought down to between three or four times that of the fluid. Dr. Hedley tested a patient under bath conditions, as nearly as he could imitate them, and found his resistance to be 540 ohms, while that of the water alone was 140 ohms.

It seems practically certain that the resistance of the body is always much greater than that of the bath water, and even after

* "Hydro-Electric Methods in Medicine," pages 43 and 44.

several minutes soakage, is generally quite three times greater than the resistance of the water in which it is immersed.

From this it is manifest that it by no means follows that because a certain battery will pass a certain c − s through a bath of water, before the patient is placed therein, it will pass the same c − s through the patient when he is in position. It will do nothing of the kind, and this leads at once to one of the most interesting and complicated problems in electro-physics.

(*c*) *In a Dipolar Bath.*—Given a bath tub of water, of known resistance, with electrodes of a certain area, and a patient of known resistance before immersion, what proportion of the c − s will pass through the patient when he is immersed in the fluid, and the current is passed from one electrode to the other, (*a*) when neither electrode touches his skin, and (*b*) when one or both touch him under water? Numerous investigators have sought a solution to this problem, but so far, I believe, without success, though some have arrived at what looks like a reasonable approximation. The absence of an accurate determination is to be regretted, for, without it, no reliable data for dosage in the dipolar bath can be established. Dr. Hedley, after elaborate and careful experiment, concludes that the body receives *about 5 per cent. only* of the total current. Steavenson and Jones previously stated, in a broad manner, and without giving any experimental data, that the proportion is *about one-eighth;* but the mere bald statement of these last-named cannot be allowed to weight against the very full and detailed investigation of the former.

Still, I cannot say that I accept Dr. Hedley's figures as conclusive. I have repeated many of his experiments, conducted others of my own, and tried in many ways to devise some arrangement for measurement which shall fully meet *all the conditions*; but there is so much that is varying, and always variable, that the x of the problem becomes a kind of hydra-headed monster, bristling with unknowns in all sorts of unexpected places.

For instance, though the diffusion of current in the water alone may be traced, and the lines of force mapped out with fair accuracy, the presence of the body at once disturbs the lines and deflects them —or at least many of them—from their direct course. This deflection, and consequent alteration of the field, might be calculated if the resistance of the body, when immersed, were known; but this, *the key to the whole problem*, has yet to be determined.

Again, the presence of the body raises the level of the water, and consequently in those bath tubs where large electrodes are fixed causes increased electrode surface to come in contact with the water. Thus another disturbing element is introduced. Yet, again, with constant current the conduction is electrolytic in the water, and more or less so in the body. This means counter E.M.Fs., which must assume appreciable proportions while the body resistance is being reduced by leakage.

The only way in which the problem can be solved is, I think, by means of specially-constructed apparatus, wherein the body and the fluid could be studied separately, without being separated more than momentarily. Such apparatus I have not yet been able to secure, though I do not think it would be difficult to devise.

In the meantime, Dr. Hedley's figures form a useful working basis, and enable the physician to have some idea of the proportion of the current which reaches his patient.

Another interesting question is that connected with what is termed local dipolar applications, *i.e.*, bringing one or both electrodes into contact with the patient under water. If the patient were a better, or even as good a conductor as the water, doubtless much useful concentration of current might result; but as the water has the lesser resistance, the current from the electrode must to a large extent radiate outwards through the water and away from the limb or other part of the body which it is intended to benefit. Of course, when a limb is just between the electrodes, the field around it, and, to some extent, through it, must be stronger than when the electrodes are some distance away; but may not this be compensated for, or even overbalanced, by the fact that the transverse resistance of a limb is far greater than its longitudinal resistance.

Having regard to these various points, it is clear that the dipolar bath is, physically, a very inefficient apparatus, from the electrical point of view, because only a small portion of the current used passes through the patient. Therapeutically, however, dipolar baths have a good record, and many physicians are content to waste current in order to produce the special effects that experience tells them is beneficial in many cases.

Monopolar baths, on the other hand, are very efficient, for all the current used must pass through the patient. Electrically, there is no waste in the process, and if reasonable attention be given to insulation, there will be practically no loss in the connections.

It may be thought that I have in this paper given undue prominence to the difficulties connected with hydro-electric methods, and so discourage their adoption and development in America. I have no intention of doing so, for, as I have stated in the paper, I believe that hydro-electric methods offer to the physician electrical opportunities which cannot be obtained by other methods, and therefore would do all I can to encourage their development. It is to further this end, and not to hinder it, that I have given prominence to difficulties and dangers which it would be unfair to pass lightly over, and which the true scientist will find pleasure in combating and overcoming.

CENTRAL ELECTRICAL LABORATORY AT PARIS.

The Central Electrical Laboratory, at 12 and 14, Rue de Stael, Paris, will include two distinct departments of study:—

1. Standards and experiments.
2. The school of application.

I.—Experimental Department.

This branch retains its former organisation. The laboratory will continue to receive pupils, admitted under the conditions laid down in the regulations.

II.—School of Application.

The object of the school of application is to give engineers that practical knowledge which the increased employment of electricity for industrial purposes has rendered a necessity.

Conditions of Admission.—Pupils of all nationalities will be admitted, without any limit as to age. Candidates not provided with a recognised diploma will have to undergo an examination in the following subjects:—Electricity (programme for the licentiate's degree for physical sciences) and mathematics; mechanics and general physics, as far as is necessary for carrying out the programme of electricity. The fees are 200 francs, to be paid in advance in two instalments, 100 francs on entering, and 100 francs on March 1st.

Instruction.—The instruction will include:

1. A course of 30 to 35 lessons on industrial electricity.
2. A course of 20 to 25 lessons on electrical measurements.
3. A series of discussions on special subjects.
4. Practical experiments in electricity.
5. Workshop practice.
6. Projects for industrial installations.
7. Visits to works.

Division of Time.—The lessons and discussions will take place in the morning from 9 to 12. The workshop and laboratory practice will be arranged for the morning or afternoon from 2 to 6. The pupils will be allowed a period of one or two months at the end of the courses for the preparation of their projects.

Examinations.—The pupils will be examined in the summer by their professors; after this examination they will have a week's holiday.

A second series of examinations will be held in June. The jury will be appointed by the directing committee of the laboratory, and chosen from among the members of the society.

Diploma.—Those pupils that satisfy the examiners will receive a diploma. They will be charged a certain sum for expenses, which will be fixed shortly.

Publicity of the Lectures and Discussions.—The lectures may be attended by any one receiving the permission of the director, on payment of a fee of 50 francs in advance.

The discussions will be open to the members of the society.*

Opening of the Course.—The course for 1894-1895 will be opened December 3rd, 1894.

NEW AYRTON-MATHER GALVANOMETER.

This instrument, which is shown by the figure, has a brass base with levelling screws and a circular level; the base carries a tripod on which a powerful permanent magnet is firmly clamped. An insulated socket connected to one terminal is fixed beneath the poles of the magnet, and carries a vertical brass tube, cut away in front for the greater part of its length. The suspension strip is fixed to a torsion-head in the upper part of the tube, but is not screwed to it

directly; it first passes through a fine hole in a thin bronze spring which yields when the instrument is set down roughly, and prevents breakage of the suspension. The lower end of the tube is fitted with an ebonite plug, through which a brass stud is screwed, whose lower end makes contact on an insulated spring attached to the remaining terminal. This stud is slotted at its upper end, and fitted with a collar and set-screw to close the slot; similar clamps are provided at the extremities of the tube containing the moving coil. The suspension strip is clamped in the upper of these, and the lower grips one end of the light spiral of phosphor bronze which connects it with the fixed stud. Thus the coil is put in circuit with the insulated terminals, and hangs with its centre of gravity accurately below the point of suspension; it can be suspended by those who would find a difficulty in soldering the connections, but soldered contacts on the coil tube may be provided for those who prefer the original arrangement.

To clamp the coil securely, a slot is cut in the brass tube, opposite the middle of the coil in which two phosphor-bronze springs work;

* Apparently the Société Internationale des Electriciens.—Eds. Elec. Rev.

when drawn back they embrace the coil and hold it firmly to the brass tube, and when pushed forward they clear it so that it swings freely. The flexibility of the connections allows this motion of the coil, and clamping does not alter the adjustments; any number of the brass suspension tubes may be fitted to one instrument, and slipping them in place makes the connections.

The cover is made in two parts, so that only the cap need be lifted off to get at the torsion-head and set the spot on the scale. Aperiodic coils are enclosed in tubes of fine silver, but ballistic coils are fixed in ivory tubes. The mirror is attached to a metal clip soldered to the prolongations of the tube.

The general adoption of the moving-coil galvanometer by electrical engineers is due to its quickness of action, aperiodicity or "dead-beatness"; and the fact that it is unaffected by the magnetic disturbances which render the use of sensitive Thomson and galvanometers in the works practically an impossibility. Owing to the comparative unsensitiveness of the early D'Arsonval galvanometers, there is an impression that they cannot be as sensitive as those with suspended magnets, but Prof. Ayrton and Mr. Mather, in 1892, showed that their pattern was more sensitive than the best Thomson galvanometers, having regard to resistance and time of swing.

Great difficulties were, however, found to arise when the extreme sensitiveness sometimes required in the laboratory were attempted, though a good working instrument could be made to give 100 mm. deflection with a millionth of an ampère. The difficulties were chiefly due to the traces of magnetism found to exist in the silk and other parts of the coil, usually considered non-magnetic, and to the fatigue of elasticity or sub-permanent set of the fine suspensions required in this case. A great number of trials were made at the Central Technical College, which showed that magnetism could be detected in almost all bodies by suspending them and noting the times of vibration within and without a magnetic field. The purest wire of electrolytic copper or of fine silver, specially drawn and covered, showed traces, and a method of treating the coils was at length devised which has practically solved this difficulty. The effect of "fatigue" of the suspension, which causes the spot to come to rest slightly above zero, may be reduced to a great extent by "ageing" the strip, *i.e.*, deflecting the coil, say, half a million times. By care in these details, and by proportioning the parts properly, the sensitiveness can now be pushed further than ever before, without destroying the good working of the instrument; while the non-magnetic property of the coil allows a magnet to be used whose field is four times as strong as those originally used in this pattern. The instruments are made by Mr. Paul, of 44, Hatton Garden, E.C.

THE PHILADELPHIA TRACTION COMPANY.

The *Electrical World* of New York gives a good account, in a recent issue, of the tramway system of Philadelphia, so far as this is under the control of the Philadelphia Traction Company. This was the first company in the city to abandon horses in favour of electricity. A map is given which shows the lines in operation or immediate contemplation by this one company. It represents the city as though covered with a gridiron of tracks, and so far as the main area of the city is concerned, we can hardly see room for the other four companies which add a further mileage of 204 to the 190 miles of equivalent single track operated by the company under review, and which have cost, exclusive of the four power stations, about £6,000 per mile. In addition to the foregoing, there is also worked by this one company, 34 miles of cable road, and 25 miles by a now nearly extinct ungulate. It contemplates, in the early future, an extension into the suburbs, which will bring up its mileage to about 300.

Only two years ago, when the company applied for permission to put in the trolley system, there was a tremendous outcry, and success only came through a flaw in the Catherine and Bainbridge Street charter, and a promise to exercise the best of care, and to pave the streets from curb to curb, in asphalte or Belgian blocks in place of cobblestones, for which Philadelphia is noted, and which have undoubtedly had their effect in helping tramway growth in Philadelphia. There are now in the city between 100 and 200 miles of trolley roads, chiefly laid in the past year, and the lines are popular, the first cars being greeted with fireworks and the inevitable brass bands, and the officials bombarded with flowers by Philadelphia's fair ones quite in Carnival style, especially for so sober a city. The opposition of two years ago has thus resulted in the city getting its streets paved across, and, also, we may add, in the feeders being placed underground, this latter a concession which the trolley system can very well grant, removing, as it does, perhaps, one of the more objectionable of the features of the system.

As, however, the concessions or "franchises" are valuable, and it does not appear that further payments to the city have been made, perhaps this street paving is not an unfair tax to be levied.

The four stations, one of which is over the Schuylkill River, and three in the city proper, aggregate 11,550 H.P., with an ultimate capacity of close upon 20,000 H.P.

Particulars of the steam plant would be out of place here, American practice in this respect differing from English in details, but being very similar in principle.

Stuttevant blowers, however, are used to produce artificial draught at the 13th and Mount Vernon Street station, with 6,000 H.P., and there are English type flue feed heaters (Green's economisers). Kerosine, also, is injected with the feed water, about 5 gallons per 2,000 H.P. per 24 hours of 150° quality, as an experiment for scale prevention. Why not try a water softening plant? Coal is conveyed mechanically to the stokehole, but hand fired. Four 10-pole dynamos are stationed here, the armature being 90 inches, and the commutator 60 inches diameter. They resemble the Westinghouse exhibit at the Chicago Fair. Induced draught is used also at the Market Street Station of 3,300 H.P.

So far as can be learned from the illustrations accompanying the description of the Mount Vernon Station, the engine rooms and electrical arrangements are good and open, but this impression is not conveyed by the illustration of the boiler house.

The fourth, or D Station, is as yet under construction. It is to have Berry vertical tubular boilers and natural draught. Vendors of steam separators will perhaps note this if the Berry boiler is tall and of no great diameter.

It is not stated why so much difference has been made in the steam plant of the several stations. The article is marked to be continued.

A LARGE TEMPORARY AMERICAN INSTALLATION.

Several of our American contemporaries publish particulars of the lighting plant of the California Exposition. This was held at San Francisco, and covered an area of 160 acres, on which were 63 buildings supplied with light; a tower and a large court of 1,000 feet by 500 feet; a total of 609 arc lights were installed, 7,256 incandescence lamps and three search lights, two of which were 30 inches and 60 inches respectively.

Five pumps were driven to supply two fountains, and the line shafting and fire pumps were also supplied with power. A further 1,876 incandescent lamps were furnished to exhibitors and 182 arcs. The charges from January 27th to July 9th were, for arc lights, £15, and for incandescent lamps, 32s. This period amounted to 1,937 hours for incandescent lamps, and 154 days arc light service.

The power necessary was derived from 8 Heine boilers rated at 375 H.P. each, and some 16 engines of various builds with pumps, &c., the total cost of installing which, complete with foundations, was close upon £6,000.

The fountains cost £3,000; wiring, £1,000; rent of engines and dynamos, &c., £3,500; installation of electric plant, £3,000.

To work the steam plant cost £9,100 for the whole period in wages, oil, and fuel, or about £3 per rated horse-power of the boilers, while the cost of running the electrical plant all told was £3,000. Adding the fountain, £4,100, the rental and wiring and general expense of the electric tower, £4,200, and about £30 for the search-light erection, gives a total of £37,266. Included in this work was 17,560 feet of underground circuits, 9,000 feet of pole circuits, 371 lamp poles in roadways, and wiring for 1,800 incandescent lamps; in all 200,000 feet of wire was used. For the fountains and the tower, distant respectively 460 and 680 feet from the dynamos, there were required 10 and 12 No. 0000 cables. These were placed underground in ducts of ordinary 1 inch planks, with internal dimensions 4 inches by 2 inches.

A continuous strip of roofing paper was laid the whole length of the ducts, the cables laid in and the edges of the strip secured by the duct cover, and no trouble arose though much of the duct was laid under a water saturated lawn. The ducts for arc wires were of 2 inches by 4 inches timber, with 1 inch by 1 inch rabbet.

On roadways, lamps (arcs) were spaced 50 feet and 75 feet; in the court, 30 feet and 35 feet. They were wired in series of five and multiples of ten when construction allowed.

16 C.P. incandescents were used in accessible places, arranged for 113, 115, and 117 volts, according to distance from station, but for places difficult of access, as on domes, 20 and 24 C.P. lamps of 120 volts were employed, and renewals were found to be nominal. Taking the month of June, the following particulars of fuel consumed are of interest.

Average daily load	13,026 horse-power hours.
Gallons of oil per day	3,617.
Pounds " "	32,116.
" " per H.P. hour ...	2·465.
Cost of 1 lb. of oil	0·56 cents (1⅛d.).
" oil per I.H.P. hour of engines ...	1·3804 cents ($\frac{7}{10}$d.).
" " incandescent lamp per month ...	16·5 cents (8¼d.).

This is looked on as a good result from plant not specially designed, the engines and dynamos being simply matched as well as possible, and only exhibited articles in operation. Everything, in fact, was of the nature of an emergency plant, and it is thought that had the official staff done all the constructive work, some 35 per cent. reduction would have been effected.

NEW PATENTS—1894.

19,560. "Improvements in the means of transmitting power from gas engines, steam engines, and the like for driving dynamos and other apparatus." F. H. Royce. Dated October 15th.

19,585. "Improvements in electric arc lamps." P. A. Mougin. Dated October 15th.

19,603. "Improvements in ceiling roses, cut-outs, and such like, for electrical purposes." C. L. Clarke and W. P. Theermann. Dated October 16th.

19,605. "Improvements in electrical conductors and joints therefor." B. Andrews. Dated October 16th.

19,654. "Improvements in telephone receivers." F. G. Bell and M. Binswanger. Dated October 16th.

19,668. "Improvements in carbons or electrodes used in arc lamps for electric lighting." A. F. B. Gomess. Dated October 16th.

19,681. "Improvements in coin-freed telephonic apparatus." W. Miller. Dated October 16th.

19,702. "Improvements in accumulators." G. E. Heyl. Dated October 16th.

19,710. "Improvements in dynamo-electric machines and motors." I. A. Timmis. Dated October 16th.

19,733. "An electric clock." W. Hearn and C. R. Gatehouse. Dated October 17th.

19,742. "Improvements in electrical switches," W. P. Theermann. Dated October 17th. (*Complete.*)

19,764. "Charging electric accumulators." J. Hopkinson. Dated October 17th.

19,782. "Improvement in or connected with whiffle-trees and traction dynamometers for road vehicles." J. Schiffer. Dated October 17th.

19,807. "Improvements in and connected with electric door contact." H. Oppenheimer. Dated October 18th.

19,842. "Improved electric storage fuse distribution box, also relating to single and double-pole fuses or cut-outs." L. H. Cline. Dated October 18th.

19,868. "An improvement in electro-deposition of an alloy of zinc and cadmium." W. A. Thoms and W. H. Burgum. Dated October 18th.

19,877. "Improvements in electrically heated grills or grates." F. W. Schindler. Dated October 18th.

19,889. "Improvements in electric arc lamps." C. T. Praed and P. R. Allen. Dated October 18th.

19,924. "Improvements in the combination of electric light with metallic bedsteads." J. W. Hoyland and W. H. Sturge. Dated October 19th.

19,934. "New or improved process for producing a porous mass specially suitable as a filling material for electric accumulators, and a new or improved accumulator adapted for the use of such filling material." G. Hubner. Dated October 19th. (*Complete.*)

19,966. "Improvements in means or apparatus relating to the supply of electrical energy to portable electric lighting apparatus." H. Birnbaum. Dated October 19th.

20,017. "Improvements in the regulating mechanism of electric arc lamps." A. G. New and A. J. Mayne. Dated October 20th.

20,043. "Improvements in arc electric lamps." W. Geipel. Dated October 20th.

20,059. "Casting by means of electric current." P. Scheidt and J. W. Tideman. Dated October 20th.

20,081. "Improvements in rapid telegraphic transmission." C. Langdon-Davies. Dated October 20th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1893.

15,050. "Slow striking electric bells." H. Oppenheimer. Dated August 5th. The automatic interruptions are arranged so that the contacts are interrupted by an intermediate mechanism. The length of such pause is regulated by the inertia of the substance forming the parts of such intermediate mechanism, the latter consisting of a fly-wheel with pinion and rack. 3 claims.

16,307. "Improvements in and connected with electric meters for alternating currents." J. Swinburne. Dated August 30th. Has reference to electrical measuring instruments in the forms of voltmeters, ampèremeters, wattmeters, ohmmeters, step indicators and meters for alternating currents. 17 claims.

17,025. "Improvements in raising and lowering the light of electric glow lamps." T. B. Sharp. Dated September 11th. Consists in connecting lamps either in series or in parallel, and arranging as switch or switches so that they can run the current either way, or shut it off altogether. 2 claims.

17,189. "Improvements in electric switches." J. M. Munro and J. McFarlane. Dated September 13th. In this invention the controlling spring is dormant and not under tension or strain of any kind when the switch is in the "on" or "off" position, and only comes into action for a very short time when the switch is being put into the "on" or "off" position. 1 claim.

17,521. "An improved method of illuminating by the electric arc." J. Jackson and W. Dixon. Dated September 18th. Consists of a screen, channel, or case, consisting, wholly or in part, of opal or obscured glass, so shaped or angled as to secure illumination where desired. The electric arc, which may or may not be surrounded by a globe or lantern, is partially or wholly enclosed by the screen, channel, or case, the sides or parts of which may or may not be movable. 3 claims.

18,115. "A new or improved electric arc lamp, specially applicable for projecting purposes, instead of the lime light." F. J. Borland. Dated September 27th. The inventor employs shunt and series coils, or solenoids, having hollow interiors closed at the outside ends, interposed between the said coils or solenoids is a hollow spindle working within which, and the said hollow interiors is a hollow central core closed at the ends, and which acts as a "dash" pot. The said coils or solenoids are joined to a bearing to which the arms or levers carrying the carbons are pivoted; or the said arms or levers may be joined direct to the hollow central core. The lever, or arm, nearest the shunt coil or solenoid is slotted and joined to the central hollow core, which has annular rings, or grooves, at both ends to make it air-tight. The lower carbon lever, or arm, has a wheel which gears with another wheel upon the top carbon lever or arm. The said bearing also carries a socket for fixing the apparatus upon a suitable spindle or stud when it is placed in working position, and terminals for connecting or joining the wires. The lower carbon arm, or lever, is graduated, and has a balance or weight thereon capable of being removed for adjustment purposes. 6 claims.

19,094. "An improved shade for oil, gas, electric, or other lights." J. F. Hoyne and G. R. Stoddart. Dated October 11th. Relates to an improved form of shade for oil, gas, electric, or other lights, which will have the effect of ventilating the space between such shade and the chimney, globe, or light to which it is applied. 1 claim.

19,688. "Improvements in safety appliances to be used in connection with electrical decomposing apparatus." J. C. Richardson. Dated October 19th. Consists in means whereby an explosive mixture, if it is formed, is not allowed to accumulate to a sufficient extent to be a source of danger. These means consist of a suitably placed burner or exploder, which will burn or explode the mixture as it is formed, and before an accumulation to any dangerous extent has taken place. 1 claim.

19,765. "Improvements in electric switches." J. L. Durward. Dated October 20th. Relates to a sliding movement for the contact bar and to pivot upon or in connection with this a pair of arms whose free ends are under spring compression so that normally the arms make an obtuse angle, and when straightened out in a straight line their points are farther apart than the normal, such extension having been effected against the spring pressure. 7 claims.

19,934. "Improved electricity meter for continuous and alternating currents." C. D. Abel. (Communicated from abroad by Compagnie Anonyme Continentale pour la Fabrication des Compteurs à Gaz et autres Appareils, Paris.) Dated October 23rd. A vertical spindle, capable of receiving reciprocating rotary motion through a certain angle, carries a bobbin situated within a fixed double electro-dynamometer coil, and below this it also carries a cylinder or ring of conducting material connected thereto by radial arms. In line with and below this spindle is a second spindle rotated by a small electro-motor, and which carries on radial arms a number of permanent horse-shoe magnets arranged symmetrically round the axis, so as, by their upward directed limbs, to embrace the lower part of the conducting cylinder. In the circuit of the motor is included a rheostat, actuated by the motion of the first-named spindle and serving to regulate the speed of the motor engine; the electro-motor also actuates through suitable speed reducting gearing a counter or registering mechanism for indicating the amount of electrical energy expended. 1 claim.

20,059. "An improvement connected with medico electric bands and belts." N. Mitchell. Dated October 24th. The inventor employs gelatine admixed with an acid, and when the compound is in a liquid or semi-liquid condition, he steeps the band in it so that the centre and the interstices between the wires of the elements are charged with the compound, this by exposure becomes dry and the compound appearing on the surface is carefully wiped off till the band appears clean. When the band or belt is in use and worn next the skin (either naked or enclosed), the heat of the body will sufficiently soften the gelatine for the acid to act as an excitant. 1 claim.

20,723. "Improvements in electric measuring instruments." W. T. Goolden and S. Evershed. Dated November 2nd. Has for its objects to enable any desired scale and range of readings to be obtained by a few simple adjustments of the working mechanism; and to make such instruments as nearly as possible astatic, so that their indications are independent of extraneous magnetic forces. 4 claims.

20,883. "Improvements in brackets or supports for insulators for telegraphic, telephonic, and other like purposes." Bullers, Ltd., and E. J. Chambers. Dated November 3rd. Consists essentially of a bracket or support made so that four insulators are carried in such relative positions that the wires attached to the said insulators are situated respectively at the angles of a square in a plane cutting the said wires at right angles. 2 claims.

20,915. "Improvements in alternate current synchronisers." W. E. Ayrton and T. Mather. Dated November 4th. One terminal of the alternator is connected with one of the mains (preferably through a high resistance) whilst the other terminal and main are respectively connected to the terminals of the voltmeter. When the electromotive force of the machine is in opposite phase to that of the mains a large potential difference exists between the voltmeter terminals whereas when the two pressures are in step the potential difference acting on the instrument has a minimum value. 1 claim.

24,017. "Improvements in or relating to processes and apparatus for obtaining and depositing metals by electrolysis, and in the treatment of the metals after leaving the electrolytic bath." E. Stouls. Dated December 13th. Relates either to different phases of the work itself or to the material employed in its execution, have principally for object modifications of the mandrels, moulds, cores or cathodes, of the means of covering them with plumbago, and of the apparatus for giving them motion: methods of purifying the solutions of metallic salts used in the manufacture, and lastly, additions and modifications as regards the working or manipulation of metals on leaving the electrolytic bath. 7 claims.